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## THE FLOURISHING TELEPHONE INDUSTRY.

The busy man to-day realizes, to some extent at least, the service performed for him by the telephone, and he, also, may have some realization of the importance of this modern service to his community. He can picture faintly what would be the condition in which business would find itself if our entire telephone system should be put out of service, for, on rare instances, small illustrations of what the general result would be have been given by the burning out of one or two important city cables. But it is not likely that any one except those whose business requires them to study the telephone situation as a whole can grasp fully the significance and the extent of the development of this modern utility. Yet every year an opportunity is given those interested to get an inkling of the proportions to which this business has grown when the annual report of the American Telegraph and Telephone Company is issued. This report for the year ended December 31, 1907, has been given out.

This report is noteworthy in being the report of what may be called the thirtieth year of corporate organized work in the development of the Bell telephone system. But in other respects it is not dissimilar from previous reports, for it not only shows that the use of the telephone is still increasing, but that the rate of increase has itself increased. One can not but wonder what will be the result of this continued growth; how soon will the point of saturation be reached or approached? On the first day of this year the Bell companies alone had in service 3,839,000 stations, an increase of 768,340 over the previous year, which is at the rate of twenty-five per cent. There is now one Bell telephone station for each twenty-two persons of the total population of the United States, or nearly one for every fourth family. And it is to be remembered that the Bell companies are not the only ones in the field, as the so-called "independent companies" have also grown in numbers and size, and while statistics of these are not available, it is pretty safe to estimate that there is at least one telephone station for every third family in the country. As this development represents the work of only thirty years, some idea of the importance of the new method of communication to our modern way of living may be grasped. This device, which was said to be merely a toy when it was first exhibited, has, within a generation, become one of the most essential tools of our business and social worlds. During the past year the Bell stations alone were used for making more than 5,800,000,000 connections, an average of over 18,000,000 a day, or a daily average of about six connections for each telephone station. Since each telephone connection brings the two principals in the conversa-

tion into touch, each instrument rendered a service equivalent to an exchange of twelve messages, or letters, a day, surely an economy worth effecting. Yet the saving in this way is negligible compared with the saving in time, which is certainly the most important feature of the telephone service. It brings each user into instantaneous communication with the others, and enables him to transact his business as promptly as though the latter were in the next office.

The report of the Bell companies shows other interesting phases of development. For example, in spite of the large increase in stations, there has been actually a decrease of over two per cent in the number of employés, due to improved apparatus and organization. Another feature is the problem of furnishing prompt service at all hours of the day. This is almost as bad as the railway problem, but the telephone load peaks are broader and the falling off in the middle of the day is not so great. The average use, however, during the early hours of the morning is less than one-twentieth of the maximum rate. Since the great feature of the telephone is its prompt service, the prospect of smoothing out these peaks and securing a greater use of the equipment during the night seems slight. Indeed, as each system increases in size, it may be found that the peaks become more and more marked.

Another significant fact shown in the report is the more liberal policy which has been adopted during the past year. The manufacturing company is now permitted to sell apparatus to all applicants. It is thought that this will improve telephone service generally, and thus reflect an improvement upon the Bell companies themselves, and it is hoped also that it will lead to the development of an unoccupied territory which the companies are not in a position to open up themselves.

## PROBLEMS OF COMMUTATION AT HIGH SPEEDS.

From the earliest days of dynamo construction, the commutator has presented one of the most troublesome problems in design. Advance has been slow and painful, each designer feeling his way, usually by the cut and try method. Theories have, of course, been proposed and some of them have rendered good service, but they are based largely on empirical knowledge and have been mainly useful in the improvement of old types of apparatus; as new conditions have been introduced, experimental work has been necessary to evolve that method of design which will give the best service.

In those features of dynamo design which have to do with the problem of commutation, the cyclic nature of the progress has been rather remarkable. For example, the commutating pole and the compensating winding which are now being employed to meet the conditions imposed by the driving of direct-current generators by steam turbines are old devices which have been used and discarded several times as new conditions made them desirable and as other improvements rendered them unnecessary. The commutating pole was one of the first auxiliary devices proposed for preventing sparking, and descriptions of the early forms will be found in the older text-books, many of which are no longer in print. So, also, was the compensating winding—that is to say, a series coil placed about the armature with the idea of neutralizing the magnetic field set up by the armature winding itself. When first proposed, these two devices were but little used, because at that time there was much opportunity for improvement in other features of the design. Satisfactory commutation was secured without them and the machine was simplified by leaving them out. It is worth noting, however, that these two aids to commutation in the earlier days were not used simultaneously; they were offered as an alternative means to the same end.

More recently the dynamo designer has found it necessary to work along a new path which has been opened by the development of the steam turbine. This called for a return to high speeds which, in the much larger sizes demanded by the modern station engineer, introduced troublesome problems in both magnetic and electrical features of the design. The former were finally solved, or at least a machine has been evolved which will operate safely at steam-turbine speeds. The method in which this has been done has not made the electrical problems any simpler. The armatures must necessarily be of relatively small diameter, which makes the field design somewhat troublesome, and the devices employed for strengthening the commutator mechanically have encroached upon the space formerly allotted to the current-collecting devices. Moreover, the high speed itself has made the armature inductance a more important factor. These difficulties have been met with more or less success by a revival of the auxiliary pole for providing a commutating field and in some cases by the use, also, of the compensating winding. The latter neutralizes the armature reaction, leaving the commutating pole free to perform its single function of reversing the current in the armature conductors. But even these two auxiliary devices have not overcome all the difficulties. It has been found necessary to return to the use of copper brushes, which, for slower speed machines, have been practically entirely displaced by carbon. The copper brush, however, is objectionable because it produces greater wear on the commutator, and because its low resistance is not so favorable for quiet commutation when the field adjustments are not exactly right or the load is subject to sudden variations. In some instances the designer has gone back to the old scheme of the combined carbon and copper brush with more or less success, but there has been a general feeling that some means of using the carbon brush successfully must be devised. One such solution is now offered, this being a pneumatic brush gear, which makes it possible to hold the brush firmly, and yet flexibly, against the commutator, which is said to prevent chattering and vibration. It is a little difficult to see just how the elastic pressure of compressed air can solve a problem which could not, also, be solved by means of properly designed springs, and it seems likely that this will be found to be the case and that by making a study of the brush spring, an equally satisfactory arrangement may be secured. However, the pneumatic brush-holder is simple, and for this reason may eventually be found the better.

Another trouble arising from the high speed of the commutators of steam-turbine-driven dynamos is the heating of the

former, due to friction and to short-circuit currents. The former can only be reduced by attention to the brush pressure and the selection of the material of the brushes; the latter can be minimized by careful design of the commutating pole and compensating windings. The design of these should be such as to allow them to be adjusted to the proper conditions by trial. One result of this increased heating has been the design of ventilated commutators, which is a step beyond the ventilation of armatures. By providing longitudinal channels either between, or through, the commutator bars, air may be forced through them and an excessive rise in temperature be prevented. This development is, of course, only a means of preventing damage, due to the commutator losses, and not of reducing the losses themselves, though exigencies in design may make this plan desirable.

Looking back over what has been done, it seems likely that the compensating coil and the commutating pole have been introduced to stay. They are the logical means of meeting new conditions, though it is not impossible that improvements in design may enable us to eliminate one or both of them. But we have not yet reached the end in commutator design, and it is likely that it will be this portion of the steam-turbine-driven direct-current dynamo that will experience the greatest change within the next few years.

## SMALL WATER POWERS FOR FARM WORK.

Farming is one of the oldest and most honorable of human pursuits. On it depends to a very large degree the prosperity of a sulf-sustaining country, and the success of the farmers' crops during any year determine the prosperity of the community. Until the opening of the great agricultural West, this work was carried out in a more or less primitive manner, and even to-day, with all the boasted advance in farming methods, and with all the improved agricultural appliances, farming, compared with other pursuits, is certainly lagging behind. Much admiration has been expressed of the modern farming methods of the West, but are not these methods merely older methods used on a larger scale? In what way does a binder drawn by a dozen span of horses differ, except in size, from one drawn by a single span? The work itself, it is true, is done on a vaster scale, economy is effected, and hand labor saved. But with the exception of the reaper, and possibly one or two other devices, modern farming apparatus consists largely of modified forms of older types, and the method of operating these machines has not changed. Compared, for instance, with the advances made in transportation or in manufacturing, progress in farming certainly has been slow.

But it will be strange if before long the spirit of advance does not infuse a new life into farming methods. May we not expect that our newer power agencies will extend their influence to the work of the farm, relieving it of much of the drudgery that still exists and making the work as attractive and pleasant as any other pursuit? When this comes about, we may expect to see farming take on a new life and flourish again in places where it has long languished. Deserted farms may then be reclaimed and a profitable field of work offered to many who now crowd into the manufacturing towns in search of a surer means of livelihood.

We have seen electric power transform means of communication, revolutionize the operation of factories, completely remodel our systems of urban transportation; and it is even now threatening to drive the steam locomotive from its long-held province. Why, then, should farming be the one field of human activity which will not profit by the new power? Is it not far more likely that some time or other the magic touch of the electric transmission line will bring about equally as great changes on the farm?

In the ELECTRICAL REVIEW of March 7 the possibilities of applying electric power to farm work were discussed, and it was suggested that this might offer a desirable field for the sale of power by the large power companies that are now developing our more important water powers. This work of development is going on energetically in the South and on the Pacific Coast, two sections at the present time mainly agricultural. But it does not follow that only those states fortunate in possessing important waterfalls may benefit in this way. The work of the average farm requires but little power, and a stream too small for manufacturing purposes might still become most profitable if harnessed to carry out the light work of the farm. Indeed, this has already been done in several instances, as is shown elsewhere in this issue. Mr. Jared Van Wagenen, in an interesting article in the *Rural New-Yorker*, from which our information is obtained, tells how he made use of a small waterfall on his farm, which, though formerly used for running a small mill, had remained idle for years because a small establishment found it impossible to compete with one larger and better equipped.

By a simple installation consisting of a turbine governor and dynamo, this water power now lights the buildings on two farms and does three-fourths of the work, and all this at an expense of but a few hundred dollars, probably less than the cost of two horses—one for each farm. The cost of running the plant is practically nothing; but slight attention is needed, and a little oil and some allowance for depreciation and repairs make up the charge. In exchange for this, there is ever-ready power, ample light, cleanliness, safety, and the saving of the care and feed of horses. These features, it is said, have added about twenty-five per cent to the value of the farms. Two or three other instances might also be mentioned where equally good results have been obtained by the development of a small water power.

Where this power is situated conveniently, the farm machinery might be driven directly from the turbine, but such cases are few. On the other hand, the electric system of transmission renders the location of the water power of minor importance and makes it possible to add comforts and conveniences to the house for the benefit of the women as well. Doubtless there are many farms throughout the country fortunate in the possession of slight water powers. Here is a way in which these can be turned to advantage, bringing profit and comfort to the owner and adding to the value of his home.

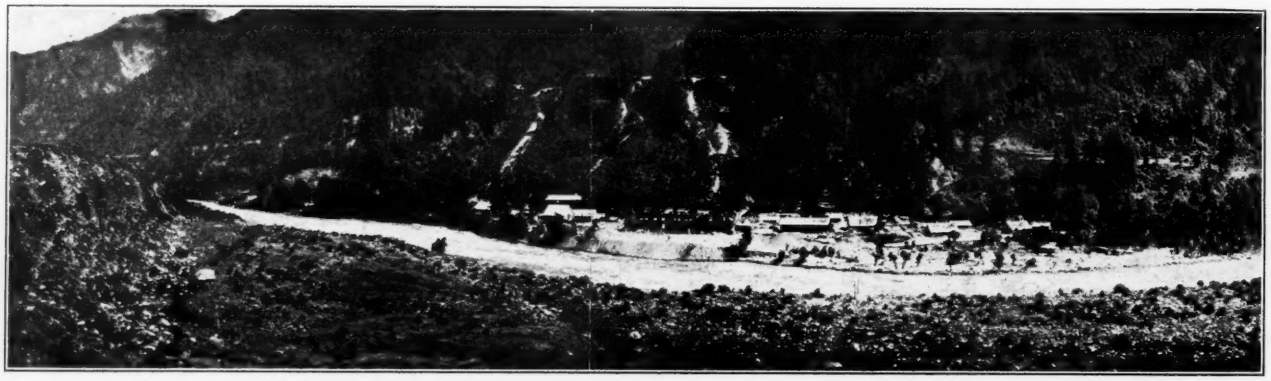
# The Kashmir Hydroelectric Works.

By Cy. Whitwell.

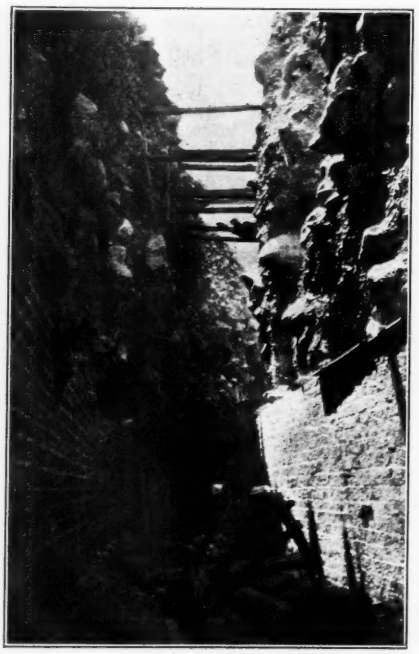
ONE of the largest and most important hydroelectric schemes that have yet been projected in the continent of Asia is that which is now approaching completion in the state of Kashmir, whereby 20,000 electrical horse-power will be available for lighting, power and other purposes within a circle of about 160 square miles. In this part of India great difficulty is encountered in securing supplies of coal, owing to the great distances separating the colliery centres from the state and the absence of native supplies, with the result that industry labors under a heavy disadvantage. On the other hand, however, there is ample horse-power running to waste in the various rivers which rise in the Himalayas, and being assured of a fairly constant supply of water by the melting snows on the highlands, the construction of extensive dams and artificial reservoirs for impounding the requisite water is found unnecessary. Under these circumstances the Kashmir Durbar decided to make avail of some of this power, and Major de Lotbiniere, who has been identified with many extensive hydroelectric schemes, notably the Cauvery Falls installation in southern India, was invited to prepare a scheme for harnessing the water within the state.

Prolonged surveys and investigation showed this engineer that the most suitable river for this scheme was the Jhelum, since it offered practically an inexhaustible supply of water even during the low-water season, the resources of other rivers within the state during this period being strictly limited and requiring the construction of dams to insure the requisite head of water the whole year round.

The Jhelum rises in, and drains a large area of, the Himalayas, and in addition is extensively fed by the glaciers on the mountainsides. Under these circumstances the river is always fairly full. Indeed, at the site selected for the head works it was found that the minimum discharge of the river at that point during December and January, the period at which the water level is at its lowest, was about 5,000 cubic feet per second. There are no large falls on the river, but at the same time the gradient of the bed is fairly heavy, averaging from thirty to eighty-five feet a mile for about eighty miles of its course through the state of Kashmir. After a careful survey it was found that the most suitable point for tapping the waterway would be at Rampur, which would enable a head of water of 400 feet net to be secured in a distance of about six and one-half miles.



THE KASHMIR HYDROELECTIC WORKS ON THE JHELUM RIVER—SHOWING FLUME (SIX AND ONE-HALF MILES LONG) TERMINATING IN FOREBAY AND POWER STATION BELOW.



THE MASONRY SECTION OF FLUME IN A DEEP CUTTING, SHOWING PRINCIPLE OF CONSTRUCTION. THE CHANNEL IS ARCHED OVER AND BURIED.

At the same time, however, it was observed that there were many other points along the river course where an aggregate of 250,000 horse-power could be developed economically, but they were not so suitable, since there were not the same facilities for disposing of the power generated as at the selected point.

The undertaking possesses many striking features from an engineering point of view which render it of more than passing interest. In the first place, the valley of Kashmir is very subject to floods during the season when the river is at its highest level, with the result that it overflows its banks, inundating the surrounding country over a considerable area, causing widespread destruction to the farms, crops, stocks and buildings in the valley. In order to minimize this destruction, if not to prevent it completely, it is essential that the river should be improved so as to render it capable of carrying the large volume of water without overflowing. To accomplish this it is requisite to deepen and improve the bed of the river, as well as accentuating the grade, which at present is somewhat slight throughout many miles of its course in its lower reaches. For instance, for a distance of eight miles through the valley from the Woolar Lake to the outfall at Baramulla the fall is only about one inch per mile. But to carry out this task with the facilities available and coolie labor is absolutely impossible; while, similarly, the acquisition of a large steam-

operated dredging fleet was impracticable, owing to the difficulty in securing the necessary coal. Wood fuel was equally out of the question, since the heavy depletion of the state's resources in this respect for the generation of steam power in the various factories, as well as the native requirements, has developed into a serious problem. The only alternative was to utilize the electric energy that would be available from the hydroelectric station for the operation of a dredging fleet, which would entirely overcome the difficulty.

tract of rich, arable soil will have far-reaching effects upon the prosperity of the state. In order to assist in carrying off the excess flood water of the river a large spill channel was decided upon, debouching from the river at a point just above the city of Srinagar, and connecting with the river again below the town. This latter undertaking has already been completed for a distance of fifteen miles, but owing to the soil being so heavily waterlogged it can not be deepened sufficiently by hand labor, so that electrically operated

high-water season is of great violence, resembling more a foaming mountain torrent. The water is carried to the power-house six and one-half miles distant in a large flume, the longest section of which is of timber, and this constitutes one of the most striking features of the undertaking. At the site of the intake, owing to the river bed falling sharply—it has a six per cent drop—the conditions were favorable for enabling the floor of the flume to be taken rapidly above the level of the river, the flume gradient being only

INTERIOR OF TIMBER FLUME—HEIGHT, 8.3 FEET; WIDTH, 8.5 FEET; LENGTH, ABOUT FOUR MILES; CAPACITY, 500 CUBIC FEET PER SECOND.

THE TIMBER FLUME SKIRTING THE HIGH ROAD, SHOWING EXTERNAL SYSTEM OF CONSTRUCTION.

LATTICE STEEL-DECK TOP-GIRDER BRIDGE FOR CARRYING THE FLUME OVER MOUNTAIN TORRENT, SHOWING TUNNEL IN HILL-SIDE, SPAN EIGHTY FEET.

OPEN STRETCH OF MASONRY FLUME, SHOWING ARCHED-OVER TUNNEL THROUGH HILL.

The Durbar decided to adopt this latter course, and the construction of the dredging flotilla is proceeding simultaneously upon the shores of Lake Baramulla with the erection of the power station. With these appliances it will be possible to carry out the river deepening and improvement work, the ultimate result of which will be the reclamation of 100,000 acres of land. Seeing that the extent of land in the state for agricultural purposes is strictly limited, the addition of this vast

mechanical appliances will be utilized for this work also.

As already stated, the river is tapped at Rampur. Here elaborate head works for the regulating sluices, etc., have been laid down, special care in the designing and construction of these having been rendered necessary to obviate any damage being inflicted by the thousands of logs which are floated down the river by the Forest Department in the course of the year. Moreover, the river itself in the

1.05 feet to the 1,000 feet, and although the river when at its highest flood level is twenty-five feet above the floor of the flume at the intake, in the course of a few hundred feet it has dropped considerably below the artificial channel.

The flume itself has occasioned the engineer the greatest trouble, owing to the broken nature of the hillsides along which it extends. As far as possible it was built of masonry, on the cut-and-cover principle, but the surveys showed that, at the

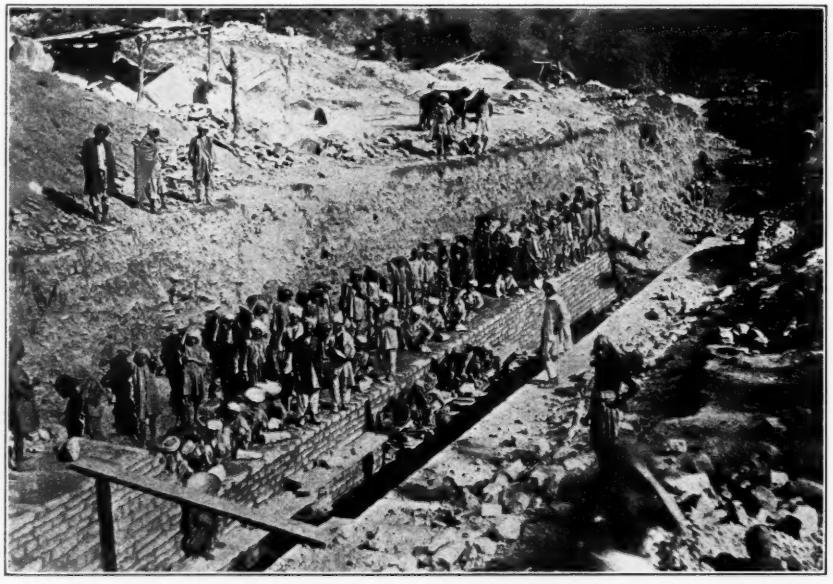
most, only about a third of the total length of the channel could be built in this manner, leaving practically four miles of flume to be built of timber. This flume line, of 500-cubic-feet-per-second capacity, is among the largest works of this description which have ever been undertaken. It is of square section, having internal dimensions of 8.3 feet by 8.5 feet. It is constructed of tongued-and-grooved, machine-planed, deodar planking 2.75 inches thick, supported in cross frames spaced 3.5 feet apart, centre to centre. The framing timbers are of common pine, ten inches square, supported on carefully levelled longitudinal sills. The roofing consists of heavy planks completely covering the interior. In order to carry out this line many obstacles had to be surmounted, such as the spanning of clefts, burrowing through projecting spurs, and the negotiation of small mountain torrents. At some places the latter were encountered at the same level as the artificial conduit, and they were only successfully passed either by burrowing beneath the bed of the stream or swinging out from the hillside and crossing by a bridge. No less than five torrents have been crossed by carrying the flume beneath, while in six other cases, owing to the position of the obstacle, lattice steel-deck top-girder bridges have had to be thrown across the gorge to carry the line, and six projecting spurs of the mountainside have had to be tunneled. The flume terminates in an excellent site upon the mountainside where it has been possible to find a suitably large level site for the erection of the forebay, while a sharp, even grade is offered for the penstocks, and an extensive site for the power-house upon a level stretch at the foot of the hill fringing the river.

The power-house, though designed for an ultimate aggregate of 20,000 horsepower, is at present being equipped with only four units, each rated at 1,000 kilowatts. The whole of the electric equipment is being supplied by the General Electric Company, of Schenectady, N. Y., and the generators are of the three-phase, twenty-five-cycle type. These will be driven by tangential water-wheels fitted with Lombard governors, which, together with their accessories, are being supplied by the Abner Doble Company, of San Francisco, Cal.

The current is being transmitted at the high potential of 60,000 volts, this pressure being decided upon owing to the probability of energy being required for lighting and power purposes in Rawal-Pindi, nearly 130 miles away. As it is, the transmission line is being laid to Srinagar, the capital of Kashmir, fifty miles distant, where electrical energy is to be extensively adopted for all purposes. The line is double and carried on separate wooden pole structures of gallows shape, placed 200 feet apart, the two transmission lines being spaced sixty feet apart. The insulators for carrying the line have been tested to 120,000 volts.

In regard to the dredging plant, which constitutes a prominent part of the enterprise, the operation of this will afford an interesting study to engineers, since the operation of a dipper dredge by electricity has not hitherto been adopted. The whole of the dredging fleet has been supplied by the Bucyrus Company, of Milwaukee. It comprises a large dipper dredge with bucket of four cubic yards' capacity, capable of exerting a 70,000-pound lift, two suction dredges capable of raising and transmitting 4,000 cubic yards of sand and clay per twenty-four hours, and two clam-shell derricks for unloading the ballast from the scows which attend the dipper dredge. The hulls of the dredges are of wood and have been built in Kashmir, while the three-phase induction motors, transformers and other electrical equipment have been furnished by the General Electric Company. Two 60,000-volt substations are being built for the dredging work, upon which will be installed the step-down transformers and requisite switching apparatus, the connection with the dredges being effected by flexible cables supported on floats.

The power supplied from these works is to be devoted to a variety of purposes, especially in and around Srinagar, in which city it is to be adopted for illuminating purposes as well as traction. The various mills within the area concerned devoted to the production of wool, oil, wood-pulp, rice-husking, flour, etc., owing to the difficulties at present attending the use of coal, due to its high cost and the rapidly increasing price of wood, intend to adopt electric power for driving machinery. One of the most interesting of these developments, however, and one which will be followed with great interest, is in connection with the generation of the desired heat for the 3,000 filature basins of the state silk factory. The amount of wood fuel used per annum for this purpose alone has been enormous, and has severely affected the other industries which were dependent upon this fuel in the valley. The feasibility of heating the basins by electrical means was suggested, and the preliminary experiments having proved completely successful, the work of installing the requisite plant sufficient for the whole of this factory is being carried into effect. It is estimated that some 2,000 horse-power will be absorbed in this new departure alone.



Masonry Section of Flume Under Construction, Showing Native Laborers.

A state railroad has also been projected along the valley, and although this scheme has been suspended for some considerable time, it is anticipated that the facilities for the economical supply of energy for its operation will result in its being pushed forward. It will be realized that the carrying out of such a comprehensive electrical power scheme in the north of India, in the heart of the Himalayas, and at a point to which the transportation of the requisite plant has been a matter of extreme difficulty, is an interesting engineering achievement. As a matter of fact, however, this country, owing to the abundance of rivers, is peculiarly adapted to the generation and utilization of water power, and there is no doubt but that when the present scheme is completed and in operation a decided stimulus will be imparted to the more extensive use of such energy, especially in view of the acuteness of the coal problem.

## Electric Power for Farm Work.

To the Editor of the Electrical Review:

Noting the article in the Electrical Review of March 7, page 375, headed "Electrical Power in Farm Work," I am able to send you a very interesting article published in the *Rural New-Yorker* from Jared Van Wagenen, Jr., who utilized an abandoned water power that had formerly been used for milling purposes. He installed a water-wheel and dynamo, and lights his house and barn, and that of a neighbor who lives near to the power, and gives the equipment the little necessary attentions for the light.

There are a great many farms that have small streams running through them that could easily be utilized to light the house and outbuildings and run the several machines in use on the farm. Farmers themselves do not usually have the knowledge to install such equipments, but in some cases their sons have and they are making such installations.

A young engineer might have a very enjoyable vacation and make some money in the summer by acting as consulting engineer to several farmers not too remote from each other, advising them on the construction of dams, installation of water-wheels, dynamos, lighting outfits and attachments to farm machines, and get valuable experience that would fit him finely for larger operations later.

Where it is practicable to secure a considerable pondage and a fair head of water, a comparatively small stream can be made to be very valuable to the farmer. Such a power does not necessarily need to be constant. A few hours a day for light is sufficient. This gives time for the pond to fill up. Rainy days, when water is most abundant, are the ones when the farmer most wants power. Also in winter time, when he wants more light and can use power to best advantage.

A further value for such a pond is to furnish ice for the farmer and his neighbors.

While such pondage is a small beginning, it is really where water storage for power should begin, and every power further down the stream would be benefited by it.

There are multitudes of farms all over the land where such installations would be practicable and very valuable to the farmer, and quite likely his neighbors. In some cases it would seem wise for two or more farmers on the same stream to combine and make a better development than one could make alone.

Second-hand water-wheels and dynamos can be used to good advantage in such work. Some young engineers could build up a good business, engineering such work, arranging for the farmer to do such part of the work as he could do to the best advantage, thus saving him money expense. I know there are many farmers who could be interested in making such a development, and in many cases power enough could be obtained to do some of the larger operations of the farm. I notice one at least of our enterprising manufacturers of water-wheels is advertising in farm papers for this small business, and offers to give prices for equipments and advice. Electrical manufacturers suitably situated to cater to this business could add much to their business by advertising their dynamos, etc., in a similar way in farm papers.

Edward R. Taylor.

Penn Yan, N. Y., March 11.

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[The article referred to by Mr. Taylor in the *Rural New-Yorker* of January 25, by Jared Van Wagenen, Jr., describes the method which he has employed for utilizing the small water power located on his farm. Through one of his old pasture fields runs a very small brook, and a little more than half a mile from the farmhouse is an old milldam and a decrepit sawmill. This place has been a mill site for generations. There was a grist mill there more than one hundred years ago, and a little later the site was used for a small woolen mill with half a dozen operatives. About fifty years ago the woolen mill went the way of so many small rural industries, and since that time the brook has flowed along unharnessed except to turn a ruinous old sawmill for a few weeks during the spring. However, the old dam was still there, its banks strengthened and held in place by many old willow trees.

The idleness of this potential water power worried Mr. Van Wagenen, for during eleven months of the year it did nothing but make a little noise, and it was six years before he finally devised a solution of the problem which had been haunting him. The first idea was to transmit the power from the mill to the power-house by means of a wire cable, but while this might have been practicable for a short transmission, the power available at this site would probably not have been sufficient to drive this cable alone. An examination of the stream showed that there was only between three and five horse-power available, while the distance of transmission was about 3,000 feet. Moreover, the cost of the wire-cable transmission would have been high. Mr. Van Wagenen then turned his attention to the electrical system of transmission of power, and after discussing the matter thoroughly with every one whom he could interest in the problem and reading all the books on the subject which he could lay his hand on, he decided that the only way to solve the problem was to go ahead and put in his equipment. The books gave him any amount of information about large installations, but practically nothing about a plant sufficient to supply ten or twenty incandescent lamps, which was run for a week at a time without attention and must be controlled by means of a wire from a point 700 feet away.

He decided that the water-wheel to be used was a turbine, as this is efficient and not troubled much by ice and back water. When properly installed it should run by the year with but little attention, and under favorable conditions make available about eighty per cent of the theoretical power of the water. As the amount of water available was small, it was important not to install a turbine too large for the work done, otherwise the losses in the turbine when only partially loaded would be considerably increased. The height of water fall was about fifteen feet, and a nine-inch upright turbine was installed in a wooden case which, under these conditions, should deliver about four and a half horse-power. This was belted to a three-kilowatt, 125-volt generator, which was large enough to supply about fifty ordinary sixteen-candle-power lamps. The voltage was high enough for the transmission, which, in this case, was at the most 3,000 feet. A water-wheel governor of inexpensive type was installed, which, although rather slow in its operation, was suitable for the conditions of the service. Both the governor and the dynamo are driven by quarter-turn belts directly from the right turbine shaft, thus reducing gearing and friction to a minimum, though rather hard on the belts. The turbine runs at about 500 revolutions a minute, and with a seventeen-inch pulley belted to a six-inch dynamo pulley, drives the latter at about 1,400 revolutions.

As the power plant is more than half a mile from the house, it is out of the question to go there night and morning to stop the machinery, and it did not seem desirable to allow it to run continuously night and day. Although the oiling devices are simple and as reliable as could be obtained with such small machines, the risk of incurring trouble seemed to be too great. For this reason arrangements were made with a neighbor whose house lies within 700 feet of the power-house, who, in consideration of free light for his house and barn, starts and stops the apparatus. This is accomplished by means of a wire carried from the turbine gate to the bedroom of the neighbor, this gate being a simple flap-valve, twelve by fourteen inches square, controlled by the wire and a counterweight. At five in the morning the turbine is started by pulling this wire, and when the neighbor retires at night the apparatus is shut down in the same way. Of course, occasionally something will interfere with the operation of the plant, but such troubles have been slight.

It is interesting to note the small expense of a useful equipment of this size.

All of the apparatus was new with the exception of the dynamo, which was second hand and cost about $150. A turbine will vary in cost from $60 to $200, the first figure being that for a simple naked upright wheel, which is to be placed in a wooden casing, and the latter for a horizontal wheel with an iron case. The water-wheel governor cost about $75. The cost of the line wire will vary with the distance. In this installation about 900 pounds of No. 4 and No. 5 Brown & Sharpe gauge were used. If the distance of run from the power-house is short, the entire equipment could be installed for about $350, while if economy were not observed it would be easy to run to two or three times this amount by putting in more expensive apparatus.

Another instance of utilization of small water powers for farming purposes is given in the *American Farm World* for March. This is the plant which has been installed by David M. Miner, in Oneida County, New York. Three years ago one of Mr. Miner's sons, while home for his vacation, decided to put to work the brook which passes through the farm. This he did, and now this stream runs a dynamo which supplies heat for the house and light for the house and all the farm buildings. It runs a cream separator, saws all the wood, cuts the feed, elevates the silage, heats the laundry irons, and runs the sewing machine. In fact, it is said to do four-fifths of all the work about the farm and barns that was hitherto done by hand. The expense of this plant was only a few hundred dollars, and the work was all done by Mr. Miner and his sons. It is said that this utilization of what was before wasted power has added twenty-five per cent to the value of the farm.—EDS.]

## American Society of Mechanical Engineers.

The next monthly meeting of the American Society of Mechanical Engineers will be held in the auditorium of the Engineering Societies Building, New York city, on the evening of April 14. The general subject of the meeting is "The Conservation of Our Natural Resources," which is now receiving unusual attention, because of the invitation of the President of the United States to the governors of the several states, and to the presidents of the national engineering societies, to confer with him in Washington on this important problem.

The New York meeting will be addressed by four speakers, who will consider forest preservation in its relation to water power, economy in the utilization of fuels, and the attitude of the engineer in regard to these.

Dr. Henry S. Pritchett, president of the Carnegie Foundation for the Advancement of Teaching, will be one of the speakers and will discuss "The Relation of the Engineer to the Body Politic."

## FINANCIAL REPORTS OF ELECTRIC COMPANIES.

### WEST INDIA ELECTRIC COMPANY, LIMITED.

The annual report of the West India Electric Company, Limited, was presented to the stockholders in Montreal, Quebec, on March 12. The gross earnings for the year ended December 31, 1907, were $198,845.40; the operating expenses were $94,805.31, making the net earnings $104,040.09. Fixed charges were: Interest on bonds, $30,000; government tax (four per cent on earnings), $6,953.26; rental paid to the Jamaica Light and Power Company, $10,000, making a total of $46,953.26, leaving a net surplus of $57,086.83. Gross earnings show an increase of $33,069.19, or 19.94 per cent over 1906. Of this $15,677.46 is for tramways, $15,665.20 for lighting, $1,726.53 miscellaneous.

Several changes in the board of directors were announced. S. H. Ewing becomes vice-president in place of Robert Lindsay, and Lieutenant-Colonel Jeffrey H. Burland and John Fair have been elected to fill vacancies. The board is now composed as follows: James Hutchinson, president; S. H. Ewing, vice-president; Jeffrey H. Burland, John Fair, the Hon. David McKeen, G. M. Webster and H. R. Oughtred.

### INTERNATIONAL TRACTION COMPANY.

The annual report of the International Traction Company, of Buffalo, N. Y., for the year ended December 31, 1907, shows gross earnings of $5,444,070, as against $5,024,298 in 1906. Expenses, taxes and depreciation amounted to $3,652,602, as against $3,146,273 in 1906. Charges amounted to $1,480,208, as against $1,413,172. The surplus was $312,260, as against $464,853. The surplus account is equal to 2.1 per cent on the $15,000,000 capital stock.

The service afforded to the public during the year was considerably improved over that of the previous year. The car mileage was increased 1,779,790 miles, an equivalent of nine per cent. During the year $525,327 was expended for repaving, relaying tracks with heavy rails, etc., and $865,578 for additions to equipment, track and buildings. These expenditures were charged, respectively, to the fund for depreciation and to capital account. The policy of appropriating a fund for depreciation was continued during 1907.

### ELECTRIC STORAGE BATTERY COMPANY.

The annual report of the Electric Storage Battery Company, Philadelphia, Pa., for the year ended December 31, 1907, shows gross earnings of $1,075,226, against $1,331,799 in 1906. Operating expenses were $387,021, against $401,092. The net income was $688,205, against $930,707. The other income was $133,069, making the total net income $821,274. Dividends were charged off amounting to $812,450, leaving the net surplus $8,824. The total surplus is now $3,669,327.

At the annual meeting of the company, held in Camden, N. J., on March 18, Alexander C. Humphries, of New York; Francis E. Bond, of E. B. Smith & Company, and D. Windsor were elected directors to succeed H. P. Whitney, H. H. Vreeland and Thomas Dolan, resigned. Other directors were re-elected.

### BELL TELEPHONE COMPANY OF BUFFALO.

The annual report of the Bell Telephone Company, of Buffalo, N. Y., for the year ended December 31, 1907, shows gross earnings of $1,709,679, as against $1,573,547 in 1906. Expenses were $1,072,710, as against $1,001,924. Dividends were $474,414, against $435,600, leaving a balance of $162,555, against $136,023. There was charged to depreciation $162,555, leaving no surplus. The net earnings were equal to 7.8 per cent on the $8,122,700 capital stock. At the end of the year there were 54,575 stations, as against 52,870 in 1906.

## Ithaca Section American Institute of Electrical Engineers.

At a meeting of the Ithaca section of the American Institute of Electrical Engineers, held February 21 at Cornell University, Dr. C. P. Steinmetz's paper on "Electrical Engineering Education" was read and discussed, and the students gave the results of their own experience in class work.

Following the formal part of the meeting an informal smoker was held in the offices of the electrical engineering department.

On March 6 a profitable discussion followed the presentation of the following papers:

"The Non-Synchronous Generator in Central Station and Other Work," by W. L. Waters, abstracted by H. W. Smith.

"Some Developments in Synchronous Converters," by Charles W. Stone, abstracted by H. L. Sharp.

"Some Features of Railway Converter Design and Operation," by J. E. Woodbridge, abstracted by E. J. McIlraith.

## American Electrochemical Society.

The spring meeting of the American Electrochemical Society will be held on April 30, May 1 and 2. The headquarters and the meeting place for April 30 will be at the Hotel Ten Eyck, Albany, N. Y. On that day there will be a meeting at 10.30 A. M. for reading and discussing papers, followed at 2 P. M. by a business meeting and presentation of papers. At 8 P. M. there will be a smoker in the café of the hotel. On May 1 a meeting will be held in the morning at ten o'clock in the lecture room of Union College, Schenectady, with experimental demonstrations, an illustrated lecture, and the reading and discussion of papers. At 1 P. M. lunch will be given at the General Electric Company's works, and from 2 to 6 P. M. the plant will be thrown open for inspection by the society. At 7.30 P. M. the return trip to Albany will be begun, followed by an informal dinner at the Hotel Ten Eyck. On May 2 a meeting will be held at 9.30 A. M. at the Rensselaer Polytechnic Institute, Troy, for the reading and discussion of papers. There will be a lunch at 1 P. M. at the Rensselaer Inn, and at 2 P. M. visits to points of interest in and around Troy will be made, and a trolley ride to Saratoga, which will conclude the meeting.

The rates for hotel accommodations on the European plan are from $2 to $2.50 for single rooms without bath, $3 to $4 with a bath. Double rooms for two without bath, $3 to $3.50; with bath, $4 to $5.

The following papers have been promised for this meeting, and others are expected:

"Corrosion of Iron from the Electrochemical Standpoint," presidential address, by C. F. Burgess.

"The Electrochemistry of Light," by Dr. Wilder T. Bancroft.

"Conduction in Electrolytes," by L. Kahlenberg.

"Mercury Cathodes in Nitric Acid Solutions," by J. A. Wilkinson.

"Copper Anodes in Chloride Solutions," by Paul Dushman.

"The Potential of the Nickel Electrode," by E. P. Schoch.

"Solubility Determinations in Aqueous Alcoholic Solutions," by A. Seidell.

"Industrial Applications of Aluminum," by E. Blough.

"Power for Electrochemical Industries," by J. Meyer.

"Electrical Conductivity of Graphite," by W. Acheson Smith.

"Distillation of Turpentine in an Electric Furnace," by F. S. Snyder.

"Mathematics of the Induction Furnace," by E. F. Roeber.

"The Synthesis of Hydrocyanic Acid in the Electric Furnace," by R. S. Hutton.

Besides the above, papers are promised from the following, but the titles are not yet to hand: Professor Charles E. Munroe, Professor G. A. Hulett, Professor H. T. Barnes and Mr. A. D. Little.

## The Minnesota Electrical Association.

The first annual convention of the Minnesota Electrical Association was held at the Nicollet Hotel, Minneapolis, Minn., on February 28 and 29. The convention was called to order by the temporary chairman, A. H. Lane, of Glencoe. A discussion of the various objects and rules which should be embodied in the constitution and by-laws was held, and the subject of state regulation of central stations by means of either the State Railroad and Warehouse Commission or a separate commission was taken up. It was the sense of the meeting that a separate commission was preferable.

The constitution and by-laws adopted establish two grades of membership. Any central station in the state of Minnesota and superintendents of municipally owned plants are eligible to active membership. All electrical and consulting engineers, jobbers and manufacturers of electrical apparatus are eligible to associate membership. Only active members shall be entitled to vote, the vote of an active member being cast by its authorized delegate. The annual dues will be $5, and the first year's dues will cover the initiation fee.

The following officers were elected: President, W. R. Putnam, Red Wing; first vice-president, A. H. Lane, Glencoe; second vice-president, L. Peterson, Thief River Falls; secretary-treasurer, Ludwig Kemper, Albert Lea; members of the executive board, A. Wagner, New Ulm; R. E. Brown, Mankato; J. C. Gordon, Little Falls.

The annual convention will be held during the third week of March of each year.

## Mexican Telephone Enterprise.

A company is being formed with a capital of $1,000,000 Mexican ($500,000 American) to develop long-distance and wireless telephony between Mexico City and the port of Vera Cruz. The company is being organized through the efforts of Lic. Francisco Alfaro, who represents capitalists of London, England. The concession has been obtained by Manuel S. de Corbera and Engineer J. Sitzenstatter, and covers a period of fifty years and includes the building of lines between various towns intermediate between Vera Cruz and the capital. Some of the underground work has already been done in the port of Vera Cruz. The wireless part of the concession will be developed later, and the concessionaires are now devoting their attention to the stringing of wires between towns and the laying of additional cables in Vera Cruz.

## Electrical Supplies for the Navy Department.

The Bureau of Supplies and Accounts will open bids in Washington, D. C., on March 31 for the following electrical supplies: 500 cross-arms, 4,400 feet steel-enameled conduit, 3,400 fuses, miscellaneous electrical supplies, for delivery at Annapolis, Md.; 9,000 feet conductor, miscellaneous electrical supplies, 100 pounds rubber tape, and 3,185 feet insulated wire, for delivery at Charleston, S. C.; eighteen motors and 20,000 feet insulated wire, for delivery at Brooklyn, N. Y.

The department will open bids on April 14 for 21,800 feet single conductor and miscellaneous electrical supplies, for delivery at Puget Sound, Wash., and for one ten-horse-power motor for delivery at Mare Island, Cal.

## General Electric Company Receives Orders.

The volume of new business booked by the General Electric Company is at the rate of $40,000,000, against a low point in December of not exceeding $30,000,000 per annum. February was a rather poor month and did not show the comparative improvement over January orders which January showed over the December results. Several good-sized orders have been received this month which have brought the present rate of new business up to $40,000,000 per annum. The New York Central has ordered twelve new electric locomotives from the company. They will be of the "6,000" type now in use. The bodies will be built by the American Locomotive Company. The Interborough Rapid Transit Company has given the company an order for the electrical equipment of 125 cars.

## Civil Service Examinations for New York State and County Service.

The State Civil Service Commission will hold examinations on April 18, 1908, for the following positions: Assistant to chief engineer, Public Service Commission, First District, $3,000; assistant civil engineer, state engineer's department, $5 to $6 a day; civil engineering draftsman, $4 to $5 a day; inspector of conduits, Public Service Commission, First District, $1,200; mechanical engineer, Public Service Commission, Second District, $1,200. The last day for filing applications for these positions is April 11. Full information and application forms for any of these examinations may be obtained by addressing Charles S. Fowler, chief examiner of the commission, at Albany, N. Y.

## Annual Report of the American Telephone and Telegraph Company.

The annual report of the American Telephone and Telegraph Company for the year ended December 31, 1907, shows the following results:

| | |
|---|---|
| Profits | $23,479,290.10 |
| Interest | 7,209,902.16 |
| Balance | 16,269,387.94 |
| Dividends paid | 10,943,644.00 |
| Carried to reserve | 3,500,000.00 |
| Carried to surplus | 1,825,743.94 |

The following were the corresponding figures for the year 1906:

| | |
|---|---|
| Profits | $17,857,687.37 |
| Interest | 4,886,750.61 |
| Balance | 12,970,936.76 |
| Dividends paid | 10,195,233.50 |
| Carried to reserve | 1,773,736.62 |
| Carried to surplus | 1,001,966.64 |

Business showed a constant gain during the year, with 3,839,000 stations connected, with a total of 8,610,592 miles of wire. There were 5,997,000,000 exchange and toll calls for the year. During the past eight years $351,835,655 has been added to construction, this item amounting to $52,921,400 for 1907. For maintenance and reconstruction $36,626,667 was expended, applied out of revenue. The total amount of maintenance and reconstruction charged against revenue for the last five years was over $147,000,000. Continuing the report, President Theodore N. Vail says:

"The amount contributed by the American Telephone and Telegraph Company in 1907 by way of investment in its own long-distance plant ($1,285,000), in real estate ($585,485), and in the purchase of stock and bonds and in advances to its operating companies ($29,952,000), was in all $31,822,485, an addition of about ten per cent to its entire investment up to January 1, 1907.

"The associated operating companies of the United States (not including the American Telephone and Telegraph Company) commenced the year with rather an abnormal indebtedness. Measures were at once taken to bring this within the normal limits of current operations. This has been done and the obligations of those companies to other than the American Telephone and Telegraph Company decreased for the year $21,000,000, while the cash on hand increased at the same time $1,500,000—a net improvement in such liabilities of $22,500,000.

"During the year the Western Electric Company decreased its indebtedness $9,400,000 and increased its cash $1,150,000, making a net improvement of $10,550,000 for that company.

"The total improvement of our associate operating and manufacturing companies in the United States was $33,050,000, bringing the current and floating indebtedness of all the associated companies well within the limits of current operations.

"The Western Electric Company desired to extend its relations with our company and the associated companies, and to cover with its operations the entire telephonic field, whether connected with the Bell system or not.

"To this end contracts have been made with most of the Bell companies, and the contract between our company and the Western Electric Company has been modified in respect to the sale of telephones and telephonic apparatus.

"The business of the year 1907, considering the unusual conditions and the large contraction in business, was fairly satisfactory, if taken alone by itself. When taken in connection with the overstock from 1906, and the amount of merchandise and material on hand or in process at the beginning of the year, it shows very small profit.

"Marketable goods and merchandise on hand at the end of the year 1907 were inventoried at $2,000,000 less than cost, and concessions in prices to the amount of $335,000 were made.

"At the end of the year cash and cash assets exceeded the payables by about eighteen per cent. The quick assets, including merchandise, exceeded the payables more than two to one. The plant stands on the books at about $12,000,000, which is fifty-one per cent of the actual cost.

"During the year an issue of bonds to the amount of $15,000,000 was authorized, which will be used when conditions are favorable to provide additional working capital if needed.

"A proposition was made by our company to purchase the outstanding share capital of the Western Electric Company at a price agreed upon with some representative shareholders as fair and equitable. Over 30,000 shares have accepted the offer, making the total holdings of our company over 120,000 out of 150,000 shares.

"Attention has been given to the operating expenses with a view to bringing them down to the lowest economy consistent with the highest efficiency.

"In spite of increase in wages and the continuance of the same high standard of maintenance which has always prevailed, the ratio of expense to gross revenue has decreased so that the net revenue shows a gratifying improvement.

"Early in the year, anticipating the possibility of an uncertain financial condition, your directors authorized an offer of 219,252 shares of capital stock to the existing shareholders, at the ratio of one share to each six shares then held. Of this issue all but 9,486 shares were subscribed for and taken.

"With this issue there are now outstanding 1,525,280 shares of capital stock distributed among 23,469 shareholders, an increase of 5,275 over January 1, 1907, being an average of sixty-five shares each.

"It will be interesting to note that 1,312,502 of these shares are held by 23,453 shareholders, an average of less than fifty-six each, the balance, 212,778, being held by sixteen shareholders of 5,000 or over shares each—an average of 13,298 each. More than three-quarters of the entire share capital is held in New England.

"The policy of our company in the past has been to lease telephones, and to allow the Western Electric Company to sell only apparatus to our licensees. Believing that the best interests of all would be advanced by the general use of standard telephonic apparatus, after consultation with, and with the approval of, our associated and licensed companies, we authorized the Western Electric Company to sell both telephones and telephonic apparatus to all applicants."

COMPARATIVE STATEMENT OF EARNINGS AND EXPENSES.

| Earnings: | 1906. | 1907. |
|---|---|---|
| Dividends | $10,281,437.60 | $11,895,166.81 |
| Interest and other revenue from associated and licensed companies | 6,477,154.78 | 9,307,023.72 |
| Telephone traffic (net) | 2,705,138.05 | 3,901,653.93 |
| Real estate | 67,296.29 | 162,228.49 |
| Other sources | 178,126.84 | 433,598.31 |
| | $19,709,153.56 | $25,609,671.26 |
| Expenses | 1,851,466.19 | 2,130,381.16 |
| Net earnings | $17,857,687.37 | $23,479,290.10 |
| Deduct interest | 4,886,750.61 | 7,209,902.16 |
| | $12,970,936.76 | $16,269,387.94 |
| Dividends paid | 10,195,233.50 | 10,943,644.00 |
| Balance | $2,775,703.26 | $5,325,743.94 |
| Carried to reserve | $1,773,736.62 | $3,500,000.00 |
| Carried to surplus | 1,001,966.64 | 1,825,743.94 |
| | $2,775,703.26 | $5,325,743.94 |

ANNUAL EARNINGS AND DIVIDENDS.
1900–1907.

| Year. | Net Revenue. | Dividends Paid. | Added to Reserves. | Added to Surplus. |
|---|---|---|---|---|
| 1900 | $5,486,058 | $4,078,601 | $837,258 | $470,198 |
| 1901 | 7,398,286 | 5,050,024 | 1,377,651 | 970,611 |
| 1902 | 7,895,272 | 6,584,404 | 522,247 | 728,622 |
| 1903 | 10,564,665 | 8,619,151 | 728,140 | 1,217,374 |
| 1904 | 11,275,702 | 9,799,117 | 586,149 | 890,435 |
| 1905 | 13,034,038 | 9,866,355 | 1,743,295 | 1,424,388 |
| 1906 | 12,970,937 | 10,195,233 | 1,773,737 | 1,001,967 |
| 1907 | 16,269,388 | 10,943,644 | 3,500,000 | 1,825,744 |

The officers of the American Telephone and Telegraph Company are: Theodore N. Vail, president; Edward J. Hall, vice-president; Thomas Sherwin, vice-president; Charles P. Ware, vice-president; William R. Driver, treasurer; Charles Eustis Hubbard, secretary.

## THE ELECTROLYTIC COPPER-REFINING INDUSTRY.

BY JOHN B. C. KERSHAW, F.I.C.

The large and important industry by which copper is refined electrolytically was founded in 1869, for in that year Mr. James Elkington started a small refinery at Pembrey, in South Wales. The output of the Pembrey refinery was only slight, namely, fifteen hundredweights per day, or 250 tons per year. The process was, however, a success, and between the years 1870 and 1880 several other small refineries using the electrolytic method were started in England, France and Germany, the most important of these being that of Messrs. Bolton & Sons at Froghall, in Staffordshire, and the Norddeutsche Affinerie, at Hamburg. The growth of the next decade was more rapid as the rise of the electrical engineering industry created a demand for electrolytic copper, and the industry was started in the United States by the Balbach Company, at Newark, N. J., and by the Baltimore Smelting and Rolling Company, at Baltimore, Md. In 1890 the total output of electrolytic copper was estimated to amount to 30,000 tons, a considerable advance when compared with the Pembrey output of 1869 and 1870. Since 1890 the industry has undergone enormous expansion, chiefly in America. The process and methods employed are similar to those used by James Elkington in his small refinery at Pembrey in 1869, but the magnitude and capacity of the works has been multiplied many hundred fold. The aggregate annual output of electrolytic copper by all countries is to-day estimated at 400,000 tons, or more than one-half the raw copper production of the world.

This remarkable growth of the industry has occurred chiefly in recent years, the capacity and output of the eleven American refineries, which contribute eighty-six per cent of the total production, having been doubled within the last seven years.

The number of electrolytic refineries now operating in the different countries of the world are given below:

| | | |
|---|---|---|
| America (United States and Canada) | 11 | 86.5% } of total |
| United Kingdom | 6 | 8.8% } output. |
| Germany | 9 | |
| France | 4 | |
| Russia | 2 | |
| Austria-Hungary | 2 | |
| Japan | 2 | |
| Total | 36 | |

When one considers the nature of the electrolytic refining process, these figures are rendered more remarkable. If a small current of electricity be passed for fifteen minutes between two electrodes of pure copper, suspended in a glass beaker containing a solution of copper sulphate and a little free acid, no visible transport of copper from anode to cathode occurs, but if the electrodes be washed, dried and weighed before and after the experiment, a slight change in weight will be found. Copper has, in fact, been dissolved at the anode and deposited at the cathode by the action of the current, and if the molecular structure of the electrolyte could be rendered visible to the eye a steady drift of minutest copper particles or "ions" from anode to cathode would have been seen.

When raw copper, as, for example, that known in the trade as "blister copper," is substituted for the pure copper at the anode, the same action occurs, but in this case the impurities of the raw copper do not pass into solution, but collect upon the surface of the anode, and finally fall to the bottom of the beaker as a precipitate or sludge.

Now, one cubic inch of copper contains, roughly, 60,000 million million of these "ions," and the number of separate "ions" required to form one ton of copper is inconceivably greater than this. Yet this method of purifying copper, particle by particle, is now applied to more than one-half the copper production of the world, and a method that would appear to be fitted only for the chemist's laboratory is carried out in works of enormous magnitude and extent.

Changes have occurred in minor details of the process since it was first worked industrially at Pembrey in 1869, but these changes have not affected the principles of the process, and Titus Ulke, in his recently published monograph upon "Electrolytic Copper Refining," states that "James Elkington's process and apparatus were well conceived and needed but little improvement to bring them up to present standards." The chief changes have been, in fact, in the size of the vats used and in the substitution wherever possible of machines for hand labor. At Pembrey cylindrical earthenware vessels thirty-three inches in height and seventeen inches in diameter were employed. Each of these pots contained, when fully charged, four cathodes and six anodes.

The solution of copper sulphate passed from one to the other of these vessels by siphons, a hundred pots being placed in series on a terraced floor, in order that gravity might effect the circulation required without artificial aid. The electrodes of each pot were connected in parallel, the pots themselves in series. In the modern refineries the pots have given place to rectangular wooden vats, lead lined and measuring up to nine feet in length by three feet in width. Pumps are employed to circulate the electrolyte. The number of electrodes in a single vat has been increased to forty or sixty, and the weight of anode metal per vat may now amount to six and one-half tons.

The anodes and cathodes in each vat are generally connected in parallel, and the vats are still worked in series, but the number of vats in one set has been increased from 100 up to 250 or more, in order to permit the use of electrical currents of higher electromotive force. The anodes are now cast with lugs, by which they are supported upon two bus-bars running along each side of the vat. The cathodes are thin sheets of pure copper obtained by electrodeposition in special vats. They are provided with devices to prevent buckling and are supported by hooks from rods running transversely across the vat, and supported at the ends by two negative bus-bars, placed at a higher level than the positive bus-bars. The charging and discharging of the vats are effected by traveling cranes, which lift the whole of the electrodes in or out in one operation. The system of electrical connection just described is known as the "multiple" or Tofern system in America, but another one, known as the "series" or Hayden system, is employed in two modern refineries. In this system only the two end electrodes in each vat are connected to the current leads, the whole of the intermediate electrodes being supported on insulating blocks.

As a result, the current passes from one end of the vat to the other through the electrolyte and through the intermediate or "secondary" electrodes, and while copper is dissolved from the one face it is deposited on the other of each of these secondary electrodes.

The current density used in electrolytic refining varies from thirteen up to forty amperes per square foot. Owing to the large amount of copper locked up in the refining vats when the process is conducted on a large scale, there is every incentive to use a high-current density and to obtain a quick turn-over of the copper. But a high-current density entails working with a higher electromotive force, and this involves greater risks and losses from short circuits in the vats and elsewhere.

The nature and amount of the impuri-

ties present in the anode copper also regulates, to some extent, the current density that may be safely employed, since with a large percentage of impurities there is risk of depositing these at the cathode when very rapid deposition of the copper is attempted. The maximum current density which can be employed under ordinary conditions of work is forty amperes per square foot, and as a rule the modern refineries are worked with half this amperage. Close attention is needed to the temperature and the physical and chemical characteristics of the electrolyte, in order to keep the electrolytic refining process in satisfactory operation, and in the best-managed modern refineries constant testing of the solution in the vats for temperature, electrical resistance, acidity and copper is carried out by men specially trained for this work. Electrical devices for drawing attention to increased electromotive force and short circuits are also now being employed with success in vat management.

Anode casting machines are the latest mechanical appliances adopted in America for facilitating the heavy work in a copper refinery, and by means of these the labor costs have been greatly reduced. An ordinary furnace is generally employed with these machines, but at the new Tacoma refinery a revolving furnace constructed on the model of the black-ash revolving furnace used in the Le Blanc alkali industry is employed for melting the anode metal, and the anodes are cast by pouring the molten metal on to a series of movable trays and molds. On the chemical side the only improvement of recent years has been the addition of a slight amount of hydrochloric acid to the electrolyte in each vat. This precipitates as chloride any silver present in solution, and reduces the losses of this metal.

The "slimes" which collect on the floor of the vats contain the whole of the silver and gold of the raw copper, and are of considerable value. They are removed from the vats each time the electrodes are changed, and are heated with sulphuric acid to dissolve copper. The insoluble residue is then separated from the copper sulphate solution by filtration. The mud finally is thoroughly washed, and is then made into flat cakes by pressure. The silver and gold are extracted from this dried cake by metallurgical and chemical parting methods. The American refineries owe their rapid growth very largely to the value of these impurities of the raw copper. Ulke has estimated that over 27,000,000 ounces of silver and 346,020 ounces of gold are recovered annually from the slimes of the United States copper refineries; and this signifies that the impurities of the raw copper pay many times over for the cost of the refining operation here. The ores of copper mined in Europe and the United Kingdom do not carry such large amounts of the precious metals, and it is due to this fact, and to the moderate extent of the development of the copper-mining industry in Europe, that the European copper refineries are now far behind the American refineries in capacity and output.

The following are brief descriptions of the plant in the more notable English and American refineries:

### T. BOLTON & SONS' REFINERIES AT FROGHALL, IN STAFFORDSHIRE, AND AT WIDNES, IN LANCASHIRE.[1]

The electric current for the refinery at Froghall is provided by eight dynamos, each rated at seventy-five kilowatts and generating 1,500 amperes at fifty volts. The plant is steam driven, and the aggregate capacity is 600 kilowatts. The 550 depositing vats at Froghall are wooden tanks four feet by two and one-half feet by three and one-half feet deep, and lined with lead. Each vat when fully charged contains nineteen electrodes, arranged on the multiple system and from sixty to seventy vats are worked in series. The anodes are cast from blister copper obtained from the smelting works at Widnes, owned by the same firm, and are allowed to remain in the vats for six weeks. Under normal conditions of work four pounds of copper are deposited in each vat per hour. The electrolytic copper produced at Froghall is chiefly used in the wire works at Oakmoor, established in 1783, and owned by the same firm. The maximum producing capacity of this refinery is 8,400 tons per annum.

The refinery at Widnes is a branch of the smelting works known as the Mersey Copper Works. The electric current is supplied by four Elwell-Parker dynamos, rope driven, each of seventy-five kilowatts' capacity, and generating 1,500 amperes at fifty volts. The vats are of the same dimensions as at Froghall, and each contains ten anodes and nine cathodes when fully charged. A current density of ten amperes per square foot is said to be used at the refinery. The maximum capacity of the Widnes refinery is 4,200 tons of refined copper per annum, but no figures for the actual output have been published since 1897, and in February, 1907, the smelting works and refinery suffered great damage by fire.

[1] The details are drawn in many cases from Ulke's monograph, already referred to.

### THE ELLIOT METAL COMPANY'S REFINERY AT PEMBREY, SOUTH WALES.

The present refinery at Pembrey is owned by Elliot's Metal Company, of Birmingham and Burry Port, and has been much enlarged since the early days of the industry. The generating plant has a total capacity of 385 kilowatts, and 1,065 vats are installed. Anodes twenty-four inches long by ten inches wide are used, each faced by two cathodes twenty-four inches by four inches wide. The method of work connecting the electrodes in parallel and the vats in series is still that introduced by James Elkington in 1869. A current density of ten amperes per square foot with an electromotive force of 0.30 volt is said to be employed.

The maximum output, according to Ulke, is 130 tons per week, or 6,500 tons per year. It is interesting to note that the output of these works had been increased from 250 to 1,000 tons per annum before the works were transferred to Messrs. Elliot's Metal Company.

### THE BALBACH SMELTING AND REFINING COMPANY REFINERY.

This refinery is situated at Newark, N. J., and is the oldest of the United States refineries, having been established in 1882-83. The present output is at the rate of forty-five short tons per day, or 16,000 tons per year.

The power plant is steam driven, and consists of one 300-kilowatt and two 125-kilowatt generating units. The 300-kilowatt generator supplies 4,300 amperes at seventy volts. The refinery is equipped with 440 vats, each containing, when charged, forty electrodes arranged on the multiple system. The anodes are thirty-six inches in length by twenty-four inches wide and measure one and one-quarter inches in thickness. Each weighs from 300 to 400 pounds.

The cathodes measure thirty-six by twenty-four inches. The current density employed at this refinery is sixteen to seventeen amperes per square foot. The anodes are cast in a plant which combines Walker's standard casting apparatus with a special tilting mold, designed by Thum. The anode when cast and partially cooled is tipped off the latter on to a moving platform immersed in water, and is carried by the latter to the vat house without any handling by the operator.

### THE BOSTON & MONTANA COPPER AND SILVER MINING COMPANY REFINERY.

This refinery is one of the few in the United States operated by water power, a fifty-foot head of water being obtained

by damming the river in the neighborhood of the Great Falls smelting works of this company in Montana. A twin turbine is connected directly to two 810-kilowatt generators, and under normal conditions of running these produce each 9,000 amperes at 180 volts. The refinery is equipped with 324 vats, each nine and three-quarters feet in length by two and one-third feet wide by three and three-quarters feet deep. Each vat contains, when fully charged, twenty anodes and twenty cathodes arranged on the multiple system, the anodes being cast from two and one-half to three inches in thickness and weighing each over 600 pounds. A fully charged vat at this refinery therefore contains nearly six tons of copper. A current density of thirty to forty amperes per square foot is employed, and a vat is worked off in eighteen days. The vats are operated in three sets of 104, with an electromotive force per vat of 0.60 volt. The output of copper by this refinery is about seventy-five tons per day, or 27,000 tons per year.

THE ANACONDA MINING COMPANY'S REFINERY.

This refinery is the only other large refinery in the United States, located in the western districts close to the mines, and unlike the Great Falls refinery it is steam driven.

The generating plant comprises nine dynamos of various types and sizes, with an aggregate capacity of 2,320 kilowatts. The two vat houses contain 1,430 vats, each eight feet in length by four feet in width and depth. When fully charged each vat contains 156 electrodes arranged in a double row along the length of the vat. Each anode measures twenty-four inches by thirty-two inches by fourteen inches in thickness and weighs 230 pounds. A fully charged vat at this refinery contains, therefore, nearly eight tons of anode copper; and assuming 1,200 vats are kept constantly at work, the value of the copper present in the vats at the Anaconda refinery must approach $4,000,000. The anodes and cathodes are arranged in the vats on the multiple system, and 200 vats are worked in series, with an electromotive force per vat of 0.30 volt and a current density of ten to twenty amperes per square foot. The maximum capacity of the plant is stated by Ulke to be 200 tons per day, or 72,000 tons per annum.

In recent years the output has been only from eighty-five to 115 tons per day, equal to 33,000 tons per annum, and owing to the high cost of fuel and labor in the West, the Anaconda company is now reported to be sending its blister copper to the eastern refineries for the final refining operation, and the Anaconda refinery is reported to have been shut down.

THE UNITED METALS SMELTING COMPANY'S REFINERY AT PERTH AMBOY, N. J.

This refinery, known as the Raritan Copper Works, is the largest in the United States, and has a maximum capacity of 200 short tons of refined copper per day, equivalent to an output of 72,000 tons per annum. The Raritan refinery is dependent upon steam power, and is provided with five 600-kilowatt generating sets, each delivering 4,500 amperes at 135 volts. The vat house is of enormous extent and covers 13,300 square yards. It contains 1,600 depositing vats, each eight feet long by two feet wide by three feet deep. Each vat, when fully charged, contains twenty-two anodes and twenty-three cathodes arranged on the multiple system. The anodes weigh 400 pounds and are worked off in about forty-three days. The circulation of the electrolyte is provided for by grouping the vats in units of 200 and by providing a solution well and pump for each unit. The cathodes are thin sheets of pure copper made by electrodeposition in special "stripping" vats, of which the Raritan works has 180. The charging and discharging of the vats is effected by four traveling cranes, which run the entire length of the building. The copper sulphate solution is maintained at a mean temperature of 120 degrees Fahrenheit by means of steam-coils in the wells. The main conductors carry a current of 4,000 amperes, and this gives a current density of fifteen amperes per square foot of cathode surface. The anode casting plant consists of four fifty-ton furnaces provided with the usual mechanical casting appliances, and working in conjunction with specially designed conveyers for removing the still hot anodes to special cars.

A plant for treatment of the slimes and recovery of the silver in the form of bars 990 fine is attached to the copper refinery. The output of the precious metals by the Raritan refinery (which employs blister copper from all of the western mines as raw material) is 8,000 to 10,000 ounces of silver and 175 to 200 ounces of gold per day.

The latest erected refinery in the United States is located about six miles from the city of Tacoma, Wash., on the shores of Puget Sound, on the Pacific Coast, and is designed for treatment of the raw copper obtained from the ores of British Columbia, Alaska, California and Mexico. The refinery is operated by water-power, about 2,000 horse-power being obtained by long-distance transmission at 40,000 volts' pressure, from the generating station at Electron, in Washington County. The furnace for casting the anodes is of the rotary type and is fired with oil fuel. The anodes are of small size and average 125 pounds only in weight. The average daily output of the refinery is thirty-six tons, equivalent to 13,000 tons per year.

## Dividend Payments in Stock.

The Public Service Commission of the Second District, State of New York, has rendered an opinion that it is not lawful for electric corporations to issue stock in payment of dividends, inasmuch as such is not one of the purposes enumerated in Section 69 for which this use of stock may be made. The decision was made in the matter of the application of the Babylon Electric Light Company, of Babylon, Long Island, which asked for authority to issue capital stock to the amount of $60,000. The application was denied so far as the issuing of stock to the amount of $30,000 as dividends upon the existing capital stock is concerned. The company was given leave to present further proof as to the necessity of issuing the additional $30,000 which the application asked for, and which was to be used in extensions and improvements to the plant. The present capital is $15,000. The company has had a prosperous existence, and the application claims that the present cash value of the assets is $59,048.50. Dividends have been declared each year from 1892, varying from two per cent to nine per cent, the last four years the dividend being nine per cent.

The opinion, written by Chairman Stevens, states that it may be assumed that the stock dividend in this case would have been lawful prior to the enactment of the Public Service Commission law, but Section 69 of the law now specifies that any authorizations must be necessary for the acquisition of property, for construction, completion, extension or improvement of the plant or distributing system, for the improvement or maintenance of its service, or for the discharge or lawful refunding of its obligations; and the law requires that the commission shall state in its order that, in its opinion, the amount of capital to be secured by the issue of stock is reasonably required for one of the said purposes of the corporation. For this reason the stock dividend is now not permitted by law.

## EXPERIMENTAL DETERMINATION OF THE LOSSES IN POLE-SHOES, DUE TO ARMATURE TEETH.[1]

BY THOMAS F. WALL AND STANLEY P. SMITH.

Among the sources of loss in dynamo-electric machinery there is one which may, under certain conditions, become abnormally large. This is the loss due to the pulsations of the flux set up in the pole-shoe by the movement of the armature teeth across the pole-face. Owing to the scarcity of experimental data, the extent of this loss is difficult to estimate; and it is of importance to know under what circumstances it is desirable to use special devices—such as laminated pole-shoes—for diminishing this loss, and so improving the efficiency.

The way in which these losses arise can be understood from the following: The flux density at any point on the pole-face will vary according to the position of the armature teeth relative to that point; consequently, as the teeth move across the pole-face, the flux in the shoe will pulsate. The magnitude of these pulsations depends chiefly on the value of the mean flux density over the whole pole surface, and on the relation between the slot opening and the air-gap. The electromotive forces set up by the flux pulsations produce corresponding eddy currents, and these, in turn, tend to damp out the fluctuations. The damping action is mainly dependent on the frequency of the pulsations, the thickness of the laminations (if any), and the nature and temperature of the iron. Further, the presence of a current in the armature has a large influence on these losses, due to its distorting effect on the field and its corresponding effect on the magnitude of the flux pulsations.

It is such complications as these which render the calculation of the eddy current losses in pole-shoes difficult. Under the assumption that the flux pulsates according to a sine law, the calculation of these losses has been carried out by Potier and Rüdenberg. The formula,[2] as obtained by them, is as follows:

$$W_p = C \left\{ (k_1 - 1)\, t_1\, B_l \right\}^2 \left\{ \frac{100\, v}{t_1} \right\}^{1.5}$$

$10^{-11}$ watts per sq. dcm. of pole surface; where

C = constant.

$t_1$ = tooth-pitch in centimetres at armature circumference.

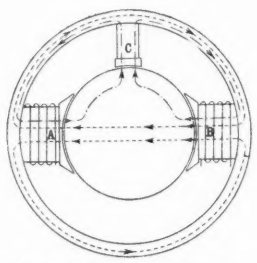
$k_1$ = ratio of the magnetic permeance of the air-gap of a smooth armature to that of a slotted armature.[1]

$B_l$ = mean flux density in air-gap.

$v$ = peripheral speed of armature in metres per second.

The flux pulsations are probably not sinusoidal, however,[2] and have, consequently, a larger form factor than a sine curve, whence it is to be expected that the above theoretical formula would give results less than those obtained by experiment. It will be presently seen that this is actually the case.

The only previous experimental work in this connection appears to have been done in the same laboratories (Karlsruhe), where the authors' experiments were carried out. This was undertaken by Mr. Dexheimer, with apparatus designed by Professor E. Arnold, in whose book a summary of the results is given.[3]




– – · – · – Flux distribution when A and B have like polarity.
– – – – – – Flux distribution when A and B have unlike polarity.

FIG. 1.—DIAGRAM OF EXPERIMENTAL MACHINE.

In this research the measurements were made as follows: The air-gap was made so large that no losses due to eddy currents were present in the pole-shoe, and the power thus required to drive the machine was accurately measured by means of a spring dynamometer. Then, with the same flux density and a decreased air-gap, the increase of power supplied was taken as equal to the losses in the pole-shoe due to the fluctuations of the flux, caused by the armature teeth. Thus, by keeping the gap constant, and using successively massive and laminated pole-shoes, the increase of the losses would be given by the difference of the readings, while the absolute losses in each case could be found from the power required to drive the machine.

From a series of experiments made in this way the following empirical formula was deduced:

$$W_p = C \left\{ (k_1 - 1)\, t_1\, B_l \right\}^{2.2} \left\{ \frac{Z\, n}{60} \right\}^{1.7}$$

$10^{-11}$ watts per sq. dcm. of pole surface; where

C = constant.

Z = number of armature teeth.

$n$ = speed in revolutions per minute, and other symbols as before.

The chief difference between this empirical formula and the above theoretical formula is that the indices of $B_l$ and $n$ are higher in the former than in the latter.

Turning now to the experiments made by the authors. A description of the method has already appeared[1], where the results of some preliminary tests were also given. The machine used for obtaining those results was the same as that used by Mr. Dexheimer in his experiments; but this machine was not well adapted to the measurement of these losses by the method devised by the authors. Hence the experiments have been repeated and extended under more favorable conditions, and the results thus obtained are given below.

The experiments are based on the assumption that the whole of the energy loss, caused by the pulsating flux, is dissipated as heat, and the method consists in measuring the heat thus dissipated. This was done by determining the amount of energy—supplied from an external and measurable source—that must be expended in order to obtain the same conditions of heating as when the actual losses are present. In other words, the heating due to eddy currents is imitated by artificial heating. It was of the highest importance, therefore, to make certain that all other forms of heating were identical in the two cases. This was done as follows:

The experimental machine was a five-horse-power dynamo with commutating poles, and had four main poles. Two of the main poles, which were diametrically opposite, were used for the production of the flux, the other two along with all the commutating poles being removed. The experimental pole-shoe was specially designed for these experiments. This was made of massive wrought iron and so arranged that the gap could be varied at will. The experimental pole is denoted by C in Fig 1, while A and B represent the main poles. Suppose now that A and B are excited in such a way that A becomes an N pole and B an S pole. The flux will then pass directly from A to B and the experimental pole C will be free from flux, provided the magnet system is symmetrical with regard to it. Under these conditions, therefore, no eddy currents

[1] Abstract of a paper read recently before the Institution of Electrical Engineers of Great Britain.

[2] *Industrie Électrique*, 1905, p. 35; *Elektrotechnische Zeitschrift*, 1905, p. 181.

[1] Arnold, *Die Gleichstrommaschine*, vol. i, second edition, p. 269.

[2] G. W. Worrall and T. F. Wall, Journal Institution of Electrical Engineers, vol. xxxvii, 1907, p. 148.

[3] Arnold, *Die Gleichstrommaschine*, vol. i, second edition, p. 648.

[1] *Electrician*, vol. lvii, p. 568.

will be induced in the experimental pole-shoe. Suppose now that the current in one of the exciting coils be reversed, the poles A and B will then have the same polarity, and the pole C will now form a return path for the flux issuing from A and B; further, while A and B have large pole-shoes in comparison with C, it is at once obvious that the flux density in the experimental pole-shoe may be made to assume high values. And experiment proved that the experimental pole-shoe, when the main poles were of unlike polarity, can, for all practical purposes, be regarded as being free from flux.

In both the above cases, however, the heating due to the exciting current in A and B is precisely the same, provided the current is kept constant throughout. It will thus be seen that when A and B have unlike polarity, the heat in the pole-shoe C is solely due to the heating of the machine; while when A and B have like polarity, the heating of the pole-shoe C will be due to exactly the same causes as before, together with the additional heating caused by the eddies and hysteresis produced by the flux pulsations in the shoe.

In passing, it may be pointed out that the iron losses in the armature will clearly not be the same when A and B have like polarity as when they have unlike polarity, and this might have an effect on the temperature of the pole-shoe. By measuring the resistance of the armature winding, however, it was found that its temperature was practically the same in the two cases, consequently its effect on the heating of the pole system was constant.

Hence it may justly be concluded that the difference of temperature of the pole-shoe in the two cases is due to, and is therefore a measure of, the losses caused by the pulsations of the flux in the shoe.

The experiment, therefore, resolves itself into finding out to what dissipation of energy this temperature difference corresponds. This was done as follows: In the experimental pole-shoe, Fig. 2, slots were cut, and in these slots resistance coils were laid. Each slot contained two coils, which could be connected non-inductively in series or parallel, as desired. Further, since the plane of the coils was perpendicular to the pole-face, any possible flux, due to the current in the resistance (or heating) coils, which may have been present, was in the worst possible direction for producing any effect which might vitiate the results when it was desired to heat the shoe artificially. When the main poles were of opposite polarity, and consequently no flux went through the experimental pole, current was sent through these coils, and, by suitably adjusting this current, it was possible to make the temperature of the shoe the same as that produced by the eddy currents when the main poles had the same polarity and the flux went through the experimental pole. When this quality of temperature was reached, the power supplied to the heating coils was measured, and this power was then taken as equal to the loss of energy produced by the flux pulsations—an assumption which the authors now proceed to justify.

From the drawing in Fig. 2 it will be seen that the resistance coils are completely embedded in the pole-shoe, so that all the heat developed by these coils must

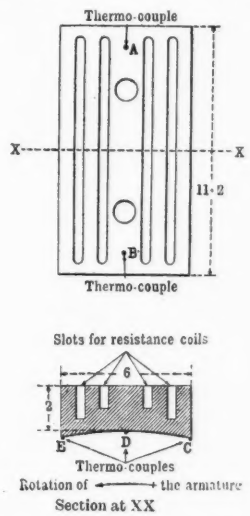



FIG. 2.—THE EXPERIMENTAL POLE-SHOE.
(Dimensions in Centimetres.)

be absorbed by the pole-shoe, to be afterward dissipated from its surface. In comparing the losses given by the present experiments with those given in the preliminary report referred to above, it may be mentioned that in the latter case the heating coils projected beyond the ends of the pole-shoe. This, coupled with the fact that the slot-openings were exceedingly wide in that case, may largely account for the fact that the losses were greater than those in the present experiments. To prevent as much as possible a transfer of heat the pole-shoe was insulated from its core by a sheet of mica.

The temperature of the pole-shoe was measured by means of thermo-couples, balanced on a potentiometer. There were five thermo-couples in all—shown by A, B, C, D and E in Fig. 2. These were made by simply soldering copper wires on the shoe at these points, while an iron wire soldered to the shoe served as a common terminal to all the couples. In this way it was possible to explore the temperature distribution over the whole shoe, both when it was heated by the losses and when it was heated artificially. This was important, since the validity of the equivalence of the artificial heating to the heating by the eddy losses depends chiefly on the distribution of the temperature being the same in the two cases.

Before any readings were taken, the machine was always allowed to run long enough for the temperature to reach an approximately steady state. The time taken for it to warm up varied from three to five hours, depending chiefly on the strength of the current in the exciting coils.

The order of each experiment was as follows: The machine was allowed to warm up with flux (and therefore eddy currents) in the experimental pole-shoe, then, after attaining a steady temperature, the electromotive forces of the thermo-couples were balanced. After this the current in one of the exciting coils was reversed and at the same time artificial heating was applied by means of the resistance coils; then, after one to two hours, the temperature would have again become steady, and the thermo-couples could be balanced. This had to be repeated, by varying the heating current in the resistance coils, until sufficient points were obtained for drawing a curve containing the point corresponding to the potentiometer readings with flux in the pole-shoe (see example in experiments A).

EXPERIMENTS A.

The first series of experiments was made to find the law connecting the eddy losses in the pole-shoe with the flux density. These losses were measured for various flux densities, and in each case reduced to the "losses per square decimetre of pole-shoe face" in watts.

Experiments A { Air-gap constant $\delta = 1.9$ mm. / Speed constant $n = 580$. / Armature current $= 0$.

These values are shown plotted in Fig. 3, the points being found by interpolation of the potentiometer readings, and the equation for the curve is

$$W_B = k\, B_l^{2.1} \text{ watts per sq. dcm.}$$

where $k$ is a constant.

If these losses are calculated from Potier's or Rüdenberg's theoretical formula, they will be found to be considerably lower than the above. Further, those obtained by Dexheimer's experimental formula are also less than those given in Fig. 3.

EXPERIMENTS B.

This series of experiments was devoted to finding the relation between the pulsa-

tion losses in the pole-shoe and the speed of the armature.

The several points were obtained in the same way as the points in the previous series of experiments, except that in the present case the only variable was the speed.

Experiments B { Air-gap constant $\delta = 1.9$ mm. Flux density constant $B_l = 5{,}800$. Armature current = 0.

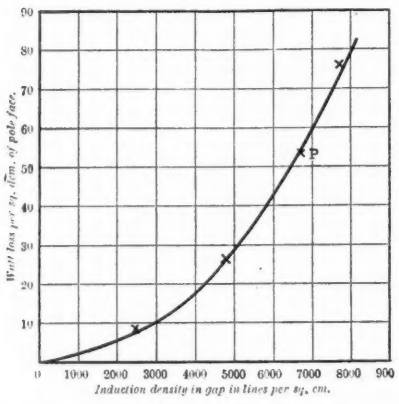



FIG. 3.—CURVE SHOWING RELATION BETWEEN LOSSES IN POLE-SHOE AND FLUX DENSITY IN AIR-GAP.

The data obtained are plotted in Fig. 4. The equation of this curve is

$$W_n = k \left( \frac{Z\,n}{60} \right)^{1.5} \text{ watts per dcm.}^2,$$

where $Z$ = number of armature teeth = 53,

$n$ = speed in revolutions per minute,

and $k$ is a constant.

EXPERIMENTS C.

The object of this series of experiments was to find the effect of the ratio of the length of the air-gap to the slot-opening on the eddy current losses in the pole-shoes. To keep the flux constant while the gap was varied the following device was used. The exciting current in the field coils was kept constant throughout, and the gap was varied by inserting pieces of cardboard between the pole-shoe and the pole-core. By this means both the magnetomotive force and the reluctance of the magnetic circuit (neglecting any alteration in the leakage coefficient brought about by the above change) were kept constant, consequently the flux must remain constant. That this was actually the case was confirmed by the ballistic galvanometer. In this way it was possible to change the effective gap, *i. e.*, the distance between the armature core and the pole-shoe, without having to take a magnetization curve in each case.

The gap was thus varied from about six millimetres to a mean value of 1.5 millimetres, but it was found that the losses were imperceptible when the gap was greater than about four millimetres.

Experiments C { Speed constant $n = 900$. Flux density constant $B_l = 6{,}000$. Armature current = 0.

It is not of much interest, however, to know how the losses vary with the length of the air-gap without at the same time knowing the relation to the opening of the slot and the width of the tooth; for upon this relation the losses depend, as expressed by the coefficient $k_1$ quoted in

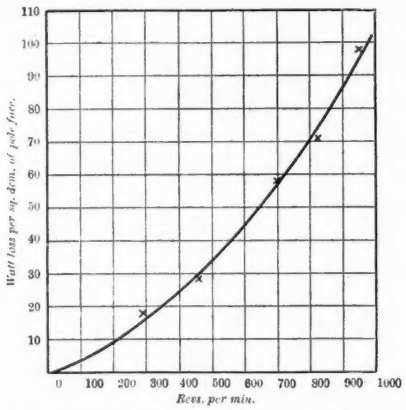



FIG. 4.—CURVE SHOWING RELATION BETWEEN LOSSES IN POLE-SHOE AND SPEED OF ARMATURE.

the formulæ in the early part of the paper. The dimensions of the teeth were: Width, ten millimetres; depth, twenty-six millimetres; width of slot, 7.2 millimetres. The diameter of the armature was 290 millimetres, while Fig. 5 is plotted from

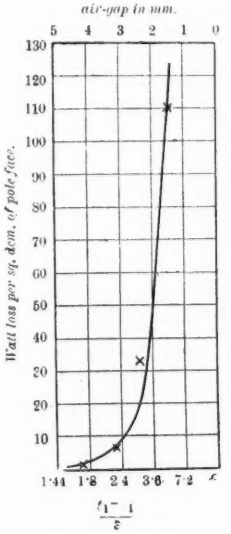



FIG. 5.—CURVE SHOWING RELATION BETWEEN LOSSES IN POLE-SHOE AND RATIO $\frac{\text{SLOT-OPENING}}{\text{AIR-GAP}}$.

the readings obtained reduced to watts per square decimetre of pole-face. The equation of this curve is

$$W_\delta = k \left( \frac{t_1 - z_1}{\delta} \right)^{3.5} \text{ watts per dcm.}^2;$$

where

$t_1$ = tooth-pitch at armature circumference,

$z_1$ = tooth-width at armature circumference,

$t_1 - z_1$ = slot-opening at armature circumference,

$\delta$ = mean length of air-gap (measured in same units at $t_1$ and $z_1$),

and $k$ = a constant.

An idea of the magnitude of the heating may be gained from the fact that, with the smallest gap (1.5 millimetres), it became impossible to hold the hand on the experimental pole-shoe after the machine had been running a few minutes.

EXPERIMENTS D.

All the previous experiments were carried out when the machine was running without current in the armature. It is also of importance, however, to know what effect the load has on the eddy losses set up in the pole-shoes by the fluctuations in the field caused by the teeth.

The current was sent through the armature as follows: When running without flux in the experimental pole the machine was driven by a motor, and current was simply passed through the armature from an external source. The armature being wave-wound, with the brushes at ninety degrees (geometrical) apart, no electromotive force, of course, was induced between the brushes due to the rotation of the armature in the field, so that the armature winding acted simply as an ohmic resistance. When running with flux in the experimental pole-shoe the machine ran as a motor, and was loaded until the same current flowed in the armature, as in the previous case. The exciting current was maintained constant throughout.

The results obtained as plotted in Fig. 6 show how the eddy losses in the pole-

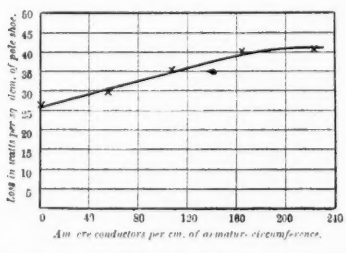

Loss in watts per sq. dcm. of pole shoe.
0 5 10 15 20 25 30 35 40 45 50
0 40 80 120 160 200 240
Am. ere conductors per cm. of armature circumference.

FIG 6.—CURVE SHOWING RELATION BETWEEN LOSSES IN POLE-SHOE AND LOAD CURRENT.

shoe increase as the load increases, which is what might have been predicted on account of the distortion of the field.

Experiments D { Air-gap constant $\delta = 1.9$ mm. Flux density constant $B_l = 4{,}700$. Speed constant $n = 600$.

The readings given by the thermo-couples in this series of experiments show clearly the distortion of the field under the pole-shoe by the fact that one of the

pole tips (C) becomes much hotter than the other (E). When artificial heating was applied the distribution of temperature differed in no way from that in the previous experiments, in which no armature current was present.

CONCLUSIONS.

Summarizing the results given by the above experiments, the following equation is obtained for the losses in pole-shoes due to eddy currents induced by the pulsations in the field set up by the armature teeth:

$$W_p = k\left(\frac{t_1 - z_1}{\delta}\right)^{3.5} B^{2.1}\left(\frac{Z\,n}{60}\right)^{1.5}$$

$10^{-11}$ watts per sq. dcm. of pole surface; where

$k$ = a constant depending on the iron, etc., = 0.046 in the present case.

Far more can be learned from the curves directly, however, than from such an equation, which can be nothing further than a comparison. Moreover, it is much better to know how to avoid these losses than how to calculate them, and to this end the above curves form a comparatively safe guide. Undoubtedly the most important of them all is the curve showing the relation between the losses and the ratio of the slot-opening to the length of the air-gap (Fig. 5). This curve—which was taken for a fairly high flux density in the gap (6,000) and a moderately high speed (900)—shows that, provided the ratio $\frac{\text{slot-opening}}{\text{air-gap}}$ does not exceed 1.5, the losses in the shoe are practically zero. Even when this ratio is as high as 1.8, the eddy losses are only some three watts, and probably the designer's practical rule of keeping this ratio below two can be accepted as about right. At any rate, this may safely be taken as the limit at which it is necessary to discard solid pole-shoes in favor of laminated. In other words, unless the gap is very small (*i. e.*, $\frac{t_1 - z_1}{\delta}$ very large), or the flux density is very great, or the speed is very high, the use of laminated shoes is not necessary, for the small increase thereby gained in efficiency does not compensate for the increased cost of construction.

## Present Steam-Turbine Development—One-and-One-Quarter-Million-Horse-Power Mark Passed.

That the steam turbine is not losing ground in its rapid introduction into all classes of power service is evidenced by the aggregate turbine business of the Westinghouse Machine Company at the beginning of the year, classified according to industries. This shows a summary of 640,700 kilowatts, or 930,000 brake horse-power. This output is distributed among 282 plants (3,298 brake horse-power per plant) and 493 machines averaging 1,886 brake horse-power per machine.

In addition to this output there were at that time under construction at East Pittsburg 148 machines. These bring the grand total of the turbine business of this company up to the figure of 864,300 kilowatts, or 1,253,000 brake horse-power, so that the one-and-one-quarter-million-horse-power mark has been passed in the operations of the Westinghouse companies alone.

The rapid advancement in steam railroading, textile mills and mining may be noted. Although there are comparatively few railroad electrification plants yet installed, their capacity is large—11,670 kilowatts per plant. In paper and textiles there are twenty-seven plants, aggregating 20,700 kilowatts, or 767 kilowatts per plant. Nineteen mining properties have adopted turbo-electric drive. Thus, while the most fruitful field for the turbine in the early days of its development was in electric traction and electric lighting work, its field has greatly broadened out into the general industries, until to-day nearly fifteen per cent of the total represents manufactures, as against thirty-four per cent electric lighting and fifty-one per cent in traction. That this result has been achieved with practically one type of turbine is a creditable reflection upon its fundamental design. An idea of the size to which modern central stations have grown is furnished by the fact that nearly thirty-five per cent of the total capacity tested is contained in stations of over 10,000 kilowatts' capacity. A decade ago, at the beginning of the turbine business, stations of this size were few and far between. To-day most large cities can boast of at least one, if not several, stations of this capacity.

In this connection some data on the development of the Parsons type turbine for marine work in Europe is of particular interest. Sir William Matthews, in his recent presidential address before the British Institute of Civil Engineers, cited the following facts:

"In the middle of the present year (1907) there were in service sixty-one steamships fitted with Parsons turbines, and sixty-five vessels under construction to be furnished with them. The total horse-power of these ships approached 1,400,000. Of this, about forty-two per cent was in merchant vessels and yachts and fifty-eight per cent in warships. In new ships of the Royal Navy, reciprocating engines have given place to turbines."

## Ohio Independent Telephone Association.

The annual convention of the Ohio Independent Telephone Association was held at the Hartman Hotel, Columbus, Ohio, on Thursday, March 19.

An address of welcome on behalf of the city was made by Assistant City Solicitor Weinland, and on behalf of the Columbus Board of Trade by Secretary J. Y. Bassell. Response to the welcome addresses was made by W. Gilbert Thompson. Frank L. Beam, president, presided.

During the morning reports of officers and committees were read and committees were appointed. During the afternoon addresses were made, problems of the telephone business discussed, and officers for the ensuing year elected. The feature of the evening was the banquet. E. O. Randall responded to "Ohio"; Dr. W. O. Thompson, "The New Citizen"; Dr. Charles S. Howe, "Industrial Education"; Cyrus Huling, "What Are We Here For?" and W. F. Laubach, "The Fathers Have Eaten Sour Grapes."

Old officers re-elected were: Frank L. Beam, president; W. O. Welsheimer, secretary; Ralph Reamer, treasurer. The vice-presidents are selected at district meetings.

Delegates to the national convention elected were: J. E. Bousch, Cleveland; W. F. Laubach, Akron; A. J. Hess, Sidney; G. H. Metheany, Lima; H. L. Beatty, Ravenna; James S. Brailey, Jr., Toledo; E. L. Barber, Wauseon; Frank L. Beam, Mt. Vernon; Judge Lewis Brucker, Mansfield; W. R. Fee, Portsmouth; L. M. Flesh, Piqua; James B. Hoge, Cleveland; W. Hyde, Warren; C. L. Jones, Athens; G. R. Johnston, Columbus; J. Mallahan, Ottawa; C. H. Marvin, Urbana; R. M. McLaughlin, Carrollton; C. Y. McVey, Cleveland; S. B. Rankin, S. Charleston; H. P. Swisher, Newark, and G. P. Thorpe, Wilmington.

The alternates are: Charles Henlein, Bridgeport; T. H. Thedieck, Sidney; F. A. Knapp, Bellevue; H. Hildebrandt, Washington Court House; D. O. O'Dell, Springfield; C. C. Heller, Beaver Dam; J. G. Steinkamp, Elmore; G. Adams, Millersburg; H. M. Allen, Troy; J. Babst, Crestline; W. H. Bowron, Caldwell; E. L. Coen, Vermilion; Charles Duncan, Chillicothe; D. H. Fuller, Clyde; A. V. Hageman, Lorain; N. Liggett, Marysville; J. McDowell, Ironton; G. E. Nungester, Celina; W. A. Norton, Kenton; J. F. Smith, Cadiz; O. L. Spangler, Bryan; S. E. Ward, Mansfield; C. D. Young, Delaware.

## ELECTRIC POWER AND LIGHTING IN A DYNAMITE PLANT.

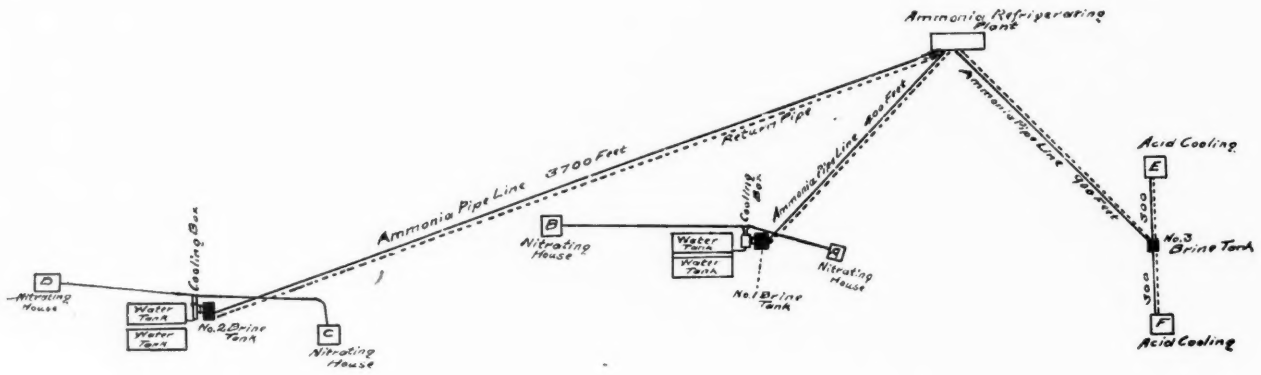
BY WARREN AIKENS.

In the manufacture of dynamite and other high explosives, electricity, which, in the form of lightning, was formerly so much dreaded, has come to play a very important part; and particularly is this true where, to the apparatus ordinarily needed, is added the necessity of operating a refrigerating plant.

The illustration printed herewith shows two motor-driven machines installed in the cooling plant of a large dynamite factory located not far from the equator, where, owing to the high temperature of the surrounding atmosphere during twelve to fifteen hours of the day, it is essential to make use of artificial cooling. These units consist of two fifty-ton Hercules machines, of the "beam" type, with ammonia condensers, driven by belts from specially wound adjustable-speed induction motors, designed for operation on three-phase, fifty-cycle alternating current, at a pressure of 440 volts.

Owing to the secrecy maintained at this plant, the writer is not authorized to make use of a complete diagram showing the layout; but the accompanying sketch will show the part played by refrigeration and electrically operated compressors in the nitrating and cleansing processes. Ammonia from the motor-driven machines is piped to three different brine tanks designated on the diagram as Nos. 1, 2 and 3, the first two of which, each fourteen feet by fourteen feet by twenty-five feet and containing no less than 8,400 lineal feet of heavy ammonia piping, are installed in connection with cooling boxes for water; the use of these will be explained later on. Six-inch pipes lead from the water tanks to each box and others carry the water away. By means of a suitable arrangement a positive counter-current circulation of brine and water is obtainable. There are also pipe connections between the cooling boxes and the nitrating houses "A" and "B" supplied by water tank No. 1 and "C" and "D" for tank No. 2. Two acid-cooling buildings, the purpose of which is also explained below, are served by brine tank No. 3. This circulating system is maintained partly by gravity and partly by the use of motor-driven centrifugal pumps, which illustrates another application of electric current in the operation of the plant.

To understand the remainder we will follow out, briefly, the process commonly used in manufacturing dynamite, omitting reference to certain special features which have no bearing on the general subject of this article.




LAYOUT OF REFRIGERATING SYSTEM OF DYNAMITE PLANT.

Nitroglycerol, the explosive component of dynamite, is a heavy oily liquid, usually made by adding glycerine to a mixture of sulphuric and nitric acids of great strength. These acids, after being cooled and mixed, are put in a lead vessel, which is kept at low temperature by a stream of water (cooled as above described) continually passing through coils in the interior of the nitrating vessel, and the glycerine is gradually introduced in a fine spray from above. The acids are forced up from the mixing tank either by an electrically propelled centrifugal pump having vanes of acid-resisting bronze (lead piping being used in all cases) or by means of compressed air supplied from a motor-driven compressor, which also furnishes air for agitating the mixture in the nitrating tank. The pump is not ordinarily needed.

Nitration of the glycerine having been effected, in about forty minutes' time, a large earthenware tap in the bottom of the lead vessel is opened, and the liquid flows by gravity to the next unit of the system, *viz.*, the separator, which is on a lower level. Here it fills to about two-thirds capacity a lead tank fitted with glass windows, through which a watch may be kept upon the process of separation. This merely means purifying the nitroglycerine from the residue of waste acids resulting from the chemical change above alluded to, which are allowed to flow away to the second separator, where any nitroglycerine that they may contain is precipitated after a more considerable interval.

The nitroglycerine passes to another tank, where it is thoroughly rinsed in water containing an alkali to neutralize any acid which may remain. Here a motor-driven compressor is also used to force air through a perforated coil in the bottom of the tank and thus agitate the washing mixture.

Following this first cleansing the nitroglycerine is sent to the filter house, which is again on a lower level and consists of a much larger building, where several charges can be washed at one time. The glycerine flows into a lead-lined tank and is covered with water, which is kept in a state of agitation by compressed air, the water being changed several times during the process. Then the charge is passed to another tank and filtered twice through flannel, thereby removing the last traces of dirt or scum.

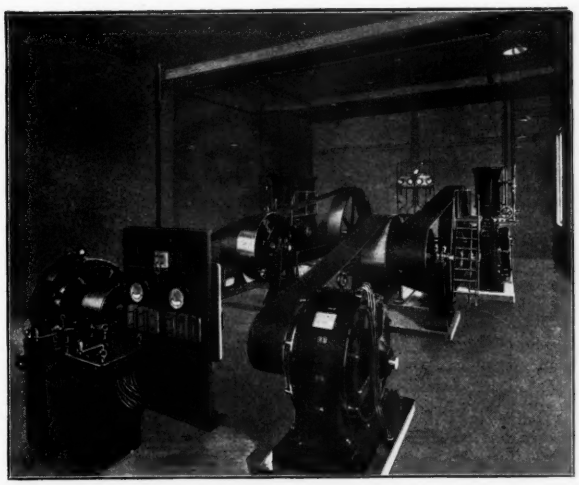
Following this operation, the product is tested, and should any impurities be shown to remain, the cleansing is carried on still further; but if a satisfactory sample is secured the nitroglycerine is allowed to stand for a day or more and then conveyed through a pipe to the "danger" zone

for mixing with kieselguhr or other absorbent, according to the grade of dynamite produced.

Crude kieselguhr, a species of silicious marl originally found in Germany, contains from fifteen to thirty-five per cent or more of water and organic matter, and before being used in the manufacture of dynamite it is first calcined in an electrically operated roasting and drying plant, then crushed between motor-driven rolls, and finally sifted, care being taken thereafter that it does not again absorb moisture, as even one-half of one per cent will have a deleterious effect in the dynamite made from it.

Both the nitroglycerine and kieselguhr, being ready for use, are mixed in lead-lined tanks in the proportion of three to one, the glycerine being weighed out into rubber buckets and poured on the guhr. The resultant product is then mixed by hand, well rubbed between the palms and sieved, when it is ready to be put up in cartridges. This is a very simple process which need not here be described, involving merely a lever press, with a native man or woman to operate it and two boys or girls to wrap the cartridges as they are squeezed out of the cylinder. The wrapping used is merely parchment paper. Every few minutes the cartridges are collected by a boy who makes the rounds of the huts where they are prepared (each press being in a separate building carefully isolated from the others) and taken to the packing room for final disposition.

It will be observed by the reader that along the route which the ingredients travel motors are used in pumping, crushing, drying and agitating, as well as for the operation of the cooling machinery, and this is done to a greater extent than we have indicated, for the reason that our space forbids going into the various refinements of the process. For example, the waste acids are treated in separators E and F, and a residue of nitroglycerine recovered by the increased use of air supplied from a compressor. Here is shown one of the principal advantages of electric drive, for the operation of small motor-driven compressors at the numerous scattered places where air is needed obviates the necessity of long lines of additional piping leading from a large central compressor and avoids loss in transmission. Furthermore, the system is more economical of power and lends itself readily to distance control. In fact, throughout a plant of this kind, where the buildings are small, scattered and inevitably located in "areas" widely separated, owing to the explosive or combustible nature of the materials used, electric motors are, by all odds, the best media of applying pressure or turning movement wherever needed. Moreover, the use of induction motors, which have no sliding contacts and are free from sparking, flashing and burning, eliminates hazard to a marked degree. Without them the relatively uneconomical application of compressed air, supplied from a distance, would be the only alternative along the route taken by the glycerine and acids, some idea of the aggregate length of which may be gathered from the sketch above referred to.



SEVENTY-FIVE-HORSE-POWER INDUCTION MOTORS DRIVING HERCULES REFRIGERATING MACHINES.

Of equal, if not greater importance, is the advantage of electric lighting; for some of the processes have to be carefully watched, by night as well as day, and the use of gas or oil would be suicidal. Of course, there are safety lamps, but in the hands of careless operatives these can not be trusted.

About the central power-house, which contains an alternating-current generator driven by a steam engine, motors are used for operating coal crushers, conveyers, etc., the same as elsewhere, and motors installed in various parts of the yards serve a number of purposes, none of which is worth special mention.

A feature of the plant which may, however, be dwelt upon briefly is the fact that the reciprocal relation existing between power production and refrigeration has, as the writer understands, been very nicely worked out here in connection with the cooling system, so that the latter costs very little compared to the quantity of electric current which it consumes. The reason for this may be readily seen after reading an article on "Refrigeration and Power-Plant Practice," which appeared in the issue of this journal for December 28, 1907. In tropical or semi-tropical countries the subject is one well worth consideration by owners or projectors of power plants of any kind; for there refrigeration can be most profitably secured "as a by-product."

While the foregoing runs very little into detail, enough has probably been said to show the advantage of using electricity to the fullest extent possible in connection with the manufacture of dynamite or other high explosives. Gun-cotton might afford an even better illustration, and tonite, cordite, axite, ballistite or gelatine compounds of various kinds have each their peculiar claims upon a system of mechanical operation which is both efficient and safe.

## The Consumption of Electricity in London.

United States Consul-General Robert J. Wynne, in a recent report, gives a brief summary of supply and consumption of electricity in the city of London, England. This report deals only with those companies and the municipal plants within the metropolitan police district. The total output of electrical energy was 87,000,000 kilowatt-hours by the municipal authorities and 213,000,000 kilowatt-hours by the private companies. The municipal authorities charged 2.6 cents per kilowatt-hour for power and heating, 7.34 cents for private lighting and 3.7 cents for public lighting. The average receipts for all purposes were at the rate of 5.126 cents per kilowatt-hour. The rates charged by the private companies were 2.9 cents per kilowatt-hour for power and heating, 7.66 cents for private lighting and 3.24 cents for public lighting. Average receipts were at the rate of 6.06 cents per kilowatt-hour. These figures show that the average rate of charge for the municipal supply is less than that of the private supply, but the report of the British Board of Trade, which has compiled these figures, gives nothing to show the financial stability of the various undertakings. The lowest rate charged is that of the West Ham municipal plant, the rate being 1.9 cents for power, 5.4 cents for private lighting and 2.78 cents for public lighting. The average price received for all the supply was 2.96 cents per kilowatt-hour.

# REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

### The Hopkinson Test Applied to a Single Dynamo.

A description is given here of a method of applying the Hopkinson test to a single dynamo, which has been worked out by A. Kolben. This is applicable to parallel-wound armatures without equalizing connections, and when the number of poles is divisible by four. The method consists in applying to one pair of brushes, diametrically opposed, current drawn from a storage battery, the other pair of brushes being short-circuited through an ammeter. Then one pair of adjacent poles is slightly weakened and the other strengthened so as to maintain the normal total flux through the machine. This causes half to act as a motor and the other as a generator, the losses only being supplied by the storage batteries. Another arrangement is to maintain the two opposite poles of similar sign of the same strength; then to strengthen one of the remaining poles, weakening the other. If the latter pole be in a vertical plane, the difference in magnetic pull on the armature will be practically compensated for by the weight of the armature, provided the stronger pole be at the top. With this arrangement, also, there should be no distortion at the two poles having normal strength; but since not all of the current set up by the generator section passes through the brushes, the commutator losses will be slightly different from those under normal operation. When tested in this way it will be found that the generator brushes operate more satisfactorily than the motor brushes, and to prevent sparking it may be advisable to shift all the brushes backward slightly. —*Abstracted from the Electrical Engineer (London), March 6.*

### Pneumatic Brush Gear and Carbon Brushes for Direct-Current Turbo-Generators.

The commutator and its auxiliaries present the most serious difficulties in the design of successful direct-current generators for steam-turbine speeds. The former part of the equipment has been made fairly satisfactory by the addition of shrink rings, which give it the necessary mechanical strength, but reduce the effective surface and introduce a possibility of arcing from brush to ring. This advance in design has left the brush problem as the most serious one for these generators, and has led to the adoption of copper brushes almost entirely, because the carbon brushes vibrate too violently at high speeds. Copper brushes not only wear the commutator severely, but are not so good for commutating, due to their low resistance. To overcome these difficulties, a new type of brush-holder has been designed by the Morgan Crucible Company, of London, one of the principal British manufacturers of carbon brushes. In this it was thought to do away with the vibration of the carbon brush by forcing it against the commutator by means of compressed air instead of by a weight or springs. In this way sufficient pressure may be secured, while the parts remain light and able to follow the commutator without vibration. The rigging consists of fixed sleeves into which the brushes are slipped and thus held in position. These holders need not be adjustable, but set once for all when special commutating poles or windings are provided. The brush is pressed up against the commutator by means of a piston sliding in a cylinder and fitted with a rubber bag so as to avoid all leakage. A porcelain tip insulates the piston rod from the top of the brush. The current is carried from the latter by means of flexible connections fastened to a copper cap pressed over the brush. Air is supplied to the brush cylinder through the rod which holds the brush-holders, this being hollow. Air pressure is maintained by means of small air accumulators or weighted cylinders, a foot-pump being provided to make up the leakage. This type of brush-holder has been used on a dynamo delivering 1,800 amperes at 110 volts, 3,300 revolutions a minute, the peripheral speed of the commutator being 7,860 feet a minute. It is said that this machine has been running night and day for a year, frequently delivering 2,000 amperes without any sparking. The commutator runs at a low temperature, in spite of the fact that it is not ventilated. A similar brush equipment was placed on a turbo-generator in the Aldershot Camp station a year ago. This is a 250-kilowatt generator running at 2,200 revolutions a minute. The machine is not provided with a compensated winding or interpoles, so in this case it was necessary to provide means for shifting the brushes.—*Abstracted from the Electrician (London), March 6.*

### Lithium in Radioactive Minerals.

The famous experiment described by Sir William Ramsay last June, which seemed to indicate a transmutation of copper into lithium, due to the action of radium emanation, has been questioned on many sides. A point seeming to have some bearing on this was the observation by Mlle. Gleditsch, that radioactive materials containing copper generally, but not always, show the presence of lithium. It was found, and this fact has been corroborated by McCoy, that there is no fixed proportionality between the copper and the lithium, seeming to indicate that there is no relation between these two materials. Sir William Ramsay does not think that this point is well taken, and in this communication he points out that in the original communication it was stated that probably sodium and, perhaps, also, potassium are products of the degradation of copper salts when in contact with radium emanation, but as both of these materials are constituents of ordinary glass, and as the experiments were carried out in glass vessels, the presence of these in the product of the reaction was not considered conclusive evidence. Lithium was mentioned because it was an unlikely constituent of dust, glass and copper, and these materials were specially tested to prove its absence; yet it was certainly contained in the treated residue. Inasmuch as the emanation in contact with water yields neon, on the probable supposition that monatomic gases are produced from the emanation, it would probably follow that the production of any particular one is dependent on surrounding conditions. It will be remembered that the gases from the action of the emanation upon a solution of copper sulphate contained no helium, but probably argon. As sodium and potassium are more widely distributed than lithium, it is more likely that they are the chief products from copper, and that some modifying circumstance has determined the formation of a trace of

lithium. Experiments now in progress in silica vessels will settle this point. There are numerous chemical analogies which might be adduced in favor of this view, and one can only be guided by such analogies in determining the line of future experiments.—*Abstracted from Nature (London), March 5.*

### The Insulator in the Making.

A description is given here of the factory of Taylor, Tunnicliff & Company, Hanley, England, where, in addition to many other kinds of pottery, insulators for electrical purposes are manufactured. As compared with ordinary pottery, the business of insulator making is highly technical, necessitating the use of specially prepared clay, special machinery and most accurate workmanship. In fact, a large staff of skilled mechanics is constantly employed in constructing and renewing machinery. The raw material is first calcined and given a preliminary crushing. It is then water-ground in large circular pans, lined with chert pavers, over which heavy stones or runners are driven. The material is thus reduced to the consistency of cream, and is fine enough to pass through silk lawns of ninety to 120 strands to the inch, through which it is forced by special machinery. It is then passed to large store arks, from which it is drawn for mixing with the various components that go to make up the "body" or clay. From these arks the material is pumped through conduits to the mixing room, where the proper blending takes place. This is an important part of the manufacture. Much depends upon the skill of the mixer to produce the proper blending of the necessary components. In some cases six or seven different materials are added together for this purpose. After the mixing, the components are again passed through silk lawns. The old process next took this material and evaporated it to the proper consistency; to-day the process consists of pumping the fluid clay through a filter press, which separates the clay from the water, leaving material of the proper consistency for forming the insulators. The first stage in the forming is to take a lump of clay which has been weighed out so as to be of the proper size, place it on the wheel, and give it by hand the proper shape. From here the soft form is taken to a drying room, where it is left until sufficiently dry to be turned up in a lathe. Here it is given its final shape and proper size, each part being complete, with the exception of the glaze. The insulators are then placed in saggars (coarse clay boxes) and stacked up in the kiln, which is gradually brought up to the proper temperature. The firing process requires about one week. Only those insulators which have dried properly without cracking are fired, and after firing they are again examined for faults and tested. After the test they are dipped in the glazing liquid, which usually contains lead, as this seems to unite the glaze more firmly with the clay and not simply give a coating of glaze over the surface of the clay. As there is some danger of lead poisoning, due to this kind of glaze, and particularly to those operators who wipe off the excess of glaze and put the insulator into final shape for the last firing, every precaution is taken at this stage to prevent this trouble. The operators are all required to wear long aprons, completely covering the clothes, and a covering over the head, and in front of each is a ventilating duct through which air is drawn constantly. The excess of glaze, as it is cut off, falls into a porcelain pan containing water. These precautions seem to be ample, as there has not been a single serious case of lead poisoning during the last five years.—*Abstracted from the Electrical Review (London), March 6.*

### The Reduction of Working Costs at the Rand Mines.

The labor available at the Rand mines in South Africa is inefficient, and consequently expensive, and the methods suggested here by G. A. Denny, he believes, would result in reducing considerably this item in the cost of operation. The author also points out the saving which may be accomplished by using mechanical power wherever possible in the place of hand labor under such conditions. He then compares the compressed-air system with the electrical system, considerably to the advantage of the latter. The former may have an efficiency at the compressor of over seventy per cent, but due to transmission losses, leakage and careless use, the efficiency is very greatly reduced and in some cases is not more than six per cent. Heavy leakage is practically unpreventable in an air system including miles of pipes of all sizes. He mentions a case where it was found necessary to run a 500-horse-power air-compressor during holidays in order to supply air for one small pump. The general practice at the Rand shows that at least thirty horse-power must be generated by the air-compressor for every rock drill in continuous operation, and if one horse-power costs $100 a year at the compressor, it will cost over $1,600 a year at the drill, assuming the low efficiency mentioned above. Regarding the electrical system, tests have shown him that when everything was taken into consideration the average efficiency from engine to point of utilization does not exceed fifty per cent; but even this rather poor showing gives the system a decided advantage when compared with compressed air or even with steam used for driving hoisting engines at a considerable distance from the boiler plant. The author believes that large central air-compressing plants are wrong. He advocates electrically driven compressors operated from a central power plant. These compressors should have a capacity not greater than 500 cubic feet of free air a minute and should be placed at various points throughout the mine, so that practically all the power is transmitted electrically. He estimates that in this way the cost of an electrical horse-power-year will be reduced from over $1,600 to about $330. The author also points out the advantage of purchasing power from a supply company when this can be done, as often in this way the cost will be less than that at which it could be generated at the mine.—*Abstracted from the Engineering and Mining Journal (New York), March 14.*

## Electric Railways in Shanghai.

The consular report states that the construction of the Shanghai street railways has been practically completed and that all cars for this system have been received and most of them have been completely fitted up. All that is now necessary to start the system is a supply of motive power for the cars. Weeks must then elapse in order that the motormen and conductors may be broken in. It is intended to use natives for this purpose, but the cars will be taken care of by foreign inspectors. There are about twenty-three miles of track in the city, and the supply system is practically complete; so that power may be turned on in a week or so. The section system has been adopted for charging, the fare being two and one-half cents for each section.

## Louisville Traction to Issue More Stock.

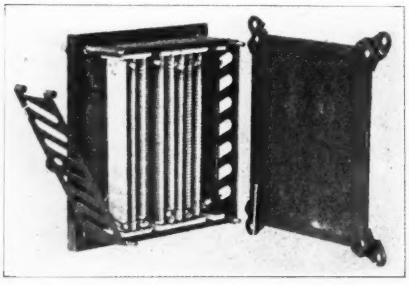
A special meeting of the stockholders of the Louisville Traction Company will be held in Jersey City on April 15 to vote upon a proposition to increase the capital stock of the company to $18,500,000 by the issue of $1,000,000 additional preferred stock, raising that issue to $3,500,000.

# INDUSTRIAL SECTION

**ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS**

## Westinghouse Direct-Current Starting Rheostats.

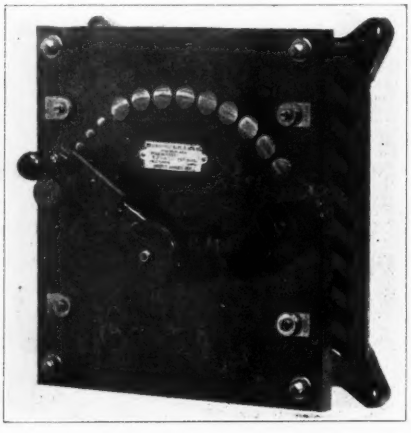
Direct-current motors, except in the smallest sizes, require some sort of starting device to keep the current within safe



BAR TYPE STARTING RESISTANCE OPEN FOR INSPECTION.

limits and also to prevent the motor from starting with too great a rush. The necessity of using satisfactory starting devices is therefore as great as to have the motor itself reliable. The Westinghouse Electric and Manufacturing Company has developed a line of face-plate starters which are thoroughly satisfactory and fully meet the specifications and conditions laid down by the National Board of Fire Underwriters and the American Institute of Electrical Engineers.

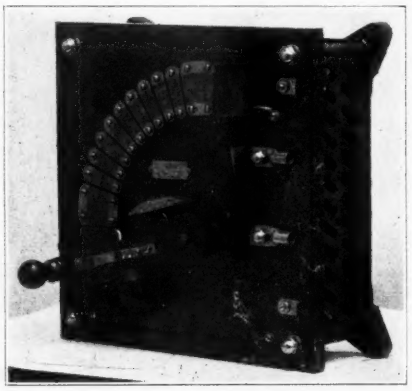
All starting rheostats are intended for use only when bringing the motor up to speed, and are not designed for regulating



FACE-PLATE STARTER, EIGHTY AMPERES' CAPACITY.

the speed. Speed-regulating rheostats may be obtained, but they are intended either to vary the field current of the motor or else they must be able to regulate the much larger armature current. The rheostat which regulates the armature current must be capable of carrying the full line current continuously. Therefore this type of rheostat is considerably more expensive than the starting rheostats which are in service for only the short and infrequent periods of starting. The lower cost of the starting rheostat does not interfere with its absolutely satisfactory operation for the intermittent service of starting for which it is designed.

The starters for motors on 110 volts up to twenty-two horse-power, or 220 volts up to thirty-five horse-power, use the bar type of resistance, which consists of a

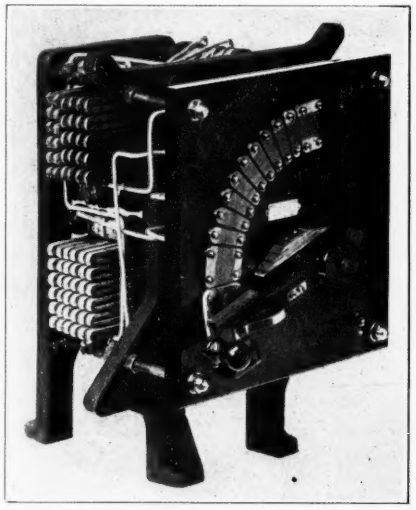


FACE-PLATE STARTER, 160 AMPERES' CAPACITY.

resistance wire wound on iron bars which are first covered with a fireproof material. The ends of the bars are held in place by porcelain pieces, clearly shown in the illustrations. The construction is strong and rigid, so that adjacent turns on the same bar can not short circuit, nor can turns on one bar come in contact with turns on another bar. The whole construction, resistance, iron frame, slate front, contact arm, etc., is fireproof.

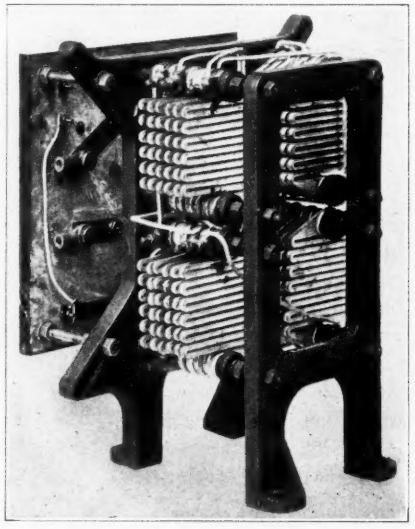
Another feature embodied in these starters is the low voltage release. The contact arm will positively fly back to the off position if the current is shut off from the line, or if the voltage falls below a fixed limit. This prevents damage to the motor should the current again be thrown on or the voltage rise suddenly to its full value. The method of connecting the magnet of the release coil will be found of special benefit where the field of the motor is to be regulated. The magnet is connected across the line independently of the shunt field and is unaffected by variations in the field current.

The small button type of rheostat shown in the illustration is used on the



GRID-TYPE STARTER, 240-AMPERE FACE PLATE.

smaller types of motors and is capable of carrying eighty amperes. For the larger motors larger contacts are required. This requirement is met by furnishing renew-



GRID-TYPE STARTER, 240-AMPERE FACE-PLATE, REAR VIEW.

able contacts, as shown in the illustration of the 160-ampere rheostat. In this larger type of starter a special short-circuiting brush is provided which cuts out the last

contact, insuring the lowest resistance possible.

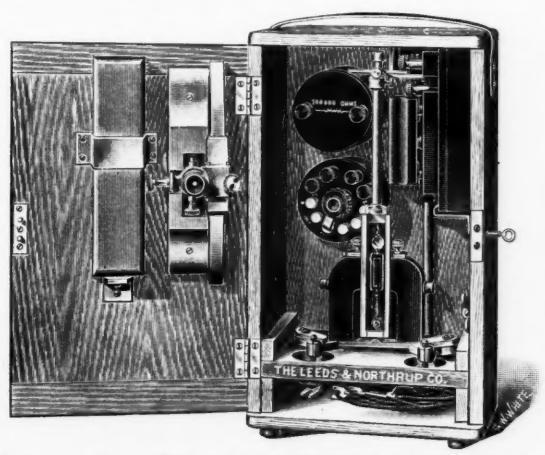
For starting motors on 110 volts of twenty-five horse-power, or 220 volts, forty-five horse-power and larger, the grid type of resistance is used, which is fully ventilated and will stand the heavy duty required in starting large motors. All contacts, brushes, fingers and springs may be removed from the front with ease.

As these rheostats are used only in starting, the handle will not remain on any point except the last, unless held. They are intended to bring the motor up to speed in fifteen to thirty seconds, according to size; are made for full-load conditions, and are adapted for 110, 220 and 550-volt motors.

## Portable Cable-Testing Galvanometer.

To meet a demand for a high-sensibility portable galvanometer for use under conditions and in places where the laboratory types can not be used, the Leeds & Northrup Company, of Philadelphia, Pa., has placed on the market the instrument illustrated herewith.

This instrument consists of one of its high-sensibility galvanometers slightly modified and mounted on a light tripod. It has ample sensibility, is quick in its action, has a positive zero and is dead beat. The tube containing the suspended system and the magnet are constructed in two units so that the tube may be removed and another substituted at any time; or, if any adjustments are to be made to the coil or system, the tube can be removed from the magnet and laid horizontally on the table. The entire system is visible by means of the open glass front given to the tube. This glass front slides in grooves and will come out readily. A simple device on the back of the instrument clamps the coil when not in use, while a spring in the top of the tube relieves the strains on the suspension while the instrument is unclamped. The suspension, thus protected, is not readily broken.




Portable Cable-Testing Galvanometer in Carrying Case.

The entire galvanometer is insulated from earth by means of the three leveling screws. These screws are made in part of hard rubber so shaped that they are "petticoated." Two small indicators, one mounted on the coil and the other on the galvanometer, enable one to level the galvanometer so that the coil always comes to exactly the same position in the field.

Portable Cable-Testing Galvanometer Set Up.

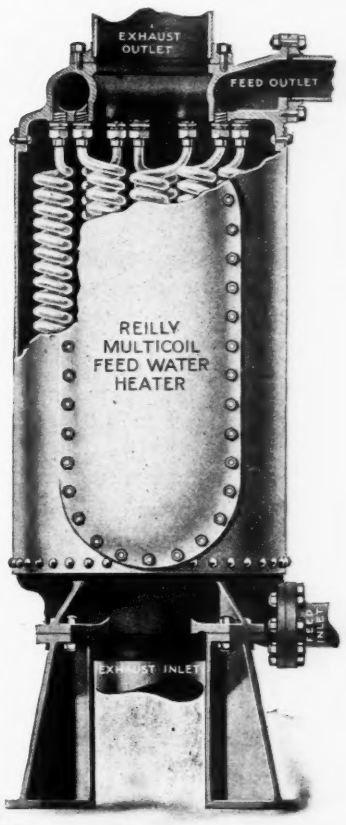
The readings are made with a small high-power telescope carried at the end of a short removable arm. The optical system is so arranged that it is easy "to find the scale." The galvanometer is clamped to the tripod by a wing nut.

With the exception of the tripod, the galvanometer complete with repair outfit packs in a case eight inches by nine inches by fifteen and one-quarter inches.

The illustrations show the galvanometer mounted on the tripod and packed in its box, together with an Ayrton shunt, 100,000 ohms, and battery key. A condenser may also be packed in. Such an equipment combines the advantages of the portable combination sets with those non-portable sets made up of a number of individual instruments.

## Multicoil Feed-Water Heaters for Stationary Service.

For many years the Reilly multicoil heater has been very popular among marine engineers on merchant ships and in a large number of government vessels. On shipboard, weight, space occupied and reliability are no less important than high efficiency. It is perhaps surprising that such a successful piece of steam-plant equipment has been so long in taking its place in stationary engineering. The James Reilly Repair and Supply Company, which for many years manufactured this heater, always confined its work exclusively to marine installations. This company has recently been enlarged and reorganized under the name of the Griscom-Spencer Company, consulting and contracting engineers in both marine and stationary power-plant work. This company is now manufacturing a line of feed-water heaters embodying the essential characteristics of the successful marine types adapted to stationary power-plant practice.




Multicoil Feed-Water Heater.

Reference to the accompanying illustration will indicate the principal details of this apparatus. The heater consists of a

shell of boiler plate with riveted seams, and provided with a large removable door, making the interior easily accessible for cleaning, inspection or repair. At the top and bottom of the heater are headers or manifolds of cast iron or cast steel, as required by the particular conditions, and provided with suitable flanges for the attachment of the inlet and exhaust pipes and feed inlet and outlet. Connecting these headers is a series of small-diameter copper coils. These coils are rolled from seamless drawn copper tubing of small diameter, and therefore of light-gauge metal. Connection between the coils and headers is made with screwed union joints ground to a steam-tight fit without packing or gaskets. Brass nipples are securely brazed to each end of the coils, the joints being afterward tested to 250 pounds. The number of coils in each heater depends upon the capacity required. The arrangement and diameter of the coils are such that there are no dead tubes or pockets; consequently, the flow of water is continuous and always balanced, maintaining a uniform circulation throughout all parts of the heater. The multiplicity of coils also sets up a violent agitation of the water coming in contact with the coils, the rapid swirling motion bringing a constantly changing film of water in contact with the heated tubes, and thus utilizing the heat in the heating elements with the greatest efficiency.

The Reilly multicoil heater is designed to give a pressure drop through the heater of from one to one and one-half pounds.

An exhaustive series of tests conducted by J. B. Spencer, of the Griscom-Spencer Company, in the steam laboratories of Columbia University, has proved a great increase in efficiency per square foot of heating surface in the small copper coils of this heater over that shown by many of the older types of feed-water heaters where larger coils or loops are employed.

These heaters are manufactured in twenty-three stock sizes, from forty-five horse-power up to 5,850 horse-power. The diameter of the latter heater is only four feet eight inches, and its height between top and bottom exhaust flanges is four feet eleven inches.

The Reilly multicoil feed-water heater is made by the Griscom-Spencer Company, 90 West street, New York city.

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The exports of copper for February, 1908, were 24,640 tons; for January, 33,019 tons. Exports for the first two months of 1907 were 26,213 tons. Imports for the first two months of 1908 were 14,300 tons; for the first two months of 1907, 20,500 tons.—*Copper Gossip.*

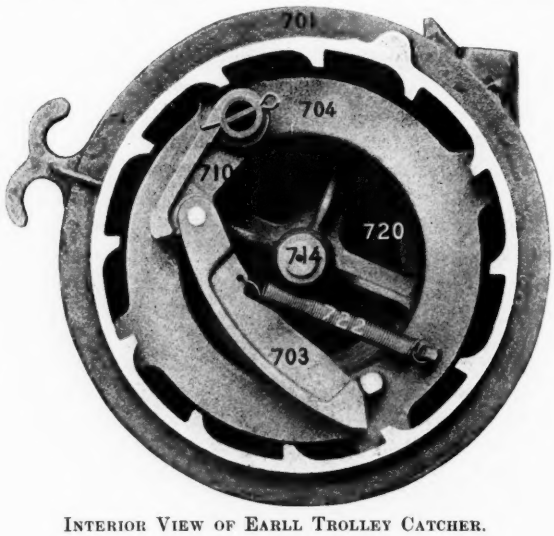
## Earll Trolley Catchers.

The Lord Electric Company, 213 West Fortieth street, New York city, is the manufacturer of a very satisfactory form of trolley catcher. This apparatus has been on the market for some time and has become very popular in street-railway service. As the result of recent tests several large orders have been placed with the company.

The No. 7 Earll catcher is shown in the accompanying illustrations, Fig. 1 showing the exterior appearance of the catcher and Fig. 2 the internal arrangement. The check pawl 710 is pivoted to the drum, and the centrifugal pawl 703 is pivoted to the check pawl. Both pawls revolve with the drum clear of the teeth in the back, 701, as the drum turns back and forth to pay out and take in slack rope under the action of the tension spring 720. When the trolley jumps, the jerk on the rope causes the centrifugal pawl to fly out and engage one of the teeth in the back, and as the drum rotates further, the check pawl 710 is forced into engagement with another tooth, thereby positively checking any further upward movement of the trolley pole. The great value of these interlocking pawls is that the thrust is so distributed as to overcome any serious wearing of the parts. The drum is not locked by the engagement of the pawls with the ratchet teeth, but merely checked to prevent the further unwinding of the rope; and should the trolley pole strike a span wire and be brought to a lower position, the drum will immediately take in the slack rope, and the pawls will reengage to check the pole in this lower position.

The No. 8 catcher is in all respects identical with the No. 7 catcher, but the emergency release consists in providing a ratchet ring having internal teeth which take the place of the teeth on the back in the No. 7 catcher. The ratchet ring also has external teeth, which are engaged by a release lever. When the end of the release lever is depressed, the ratchet ring is free to turn and the pole may then be run up to the wire at any speed. This is a valuable adjunct, for should a car be caught in a critical position, such as on a railroad crossing, with a disabled catcher, the conductor would be able at once to release the trolley rope without cutting it, and replace the trolley on the wire just as though no catcher were attached.

EXTERIOR VIEW OF EARLL TROLLEY CATCHER.




INTERIOR VIEW OF EARLL TROLLEY CATCHER.

## Thirty-six-Million-Dollar Power Company.

Following conferences with the governor and the Railroad Commission in Atlanta, Ga., and the sanctioning by the latter of the issue of $20,000,000 bonds and $16,000,000 stock, Macon members of the Central of Georgia Power Company have announced the formation of this company to develop the water powers of middle Georgia. Contracts will be entered into at once for the outlay of $25,000,000. The company will have its headquarters in Macon.

## A New System of Reflectors for Show-Window Lighting.

I. P. Frink, 551 Pearl street, New York city, has developed a line of special reflectors for show-window lighting. These reflectors are scientifically designed and give an evenly diffused light with no shades. They are made with strong metal frames lined with the Frink special silver-plated corrugated glass in sections, eliminating breakage from expansion or contraction. The fixtures are fitted with nickel-plated twin sockets for eight, sixteen or thirty-two-candle-power lamps.

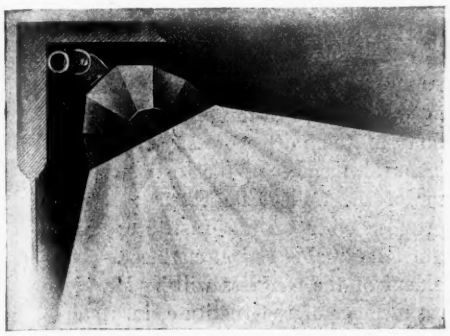


FIG. 1.—END VIEW OF PANELED-END REFLECTOR.

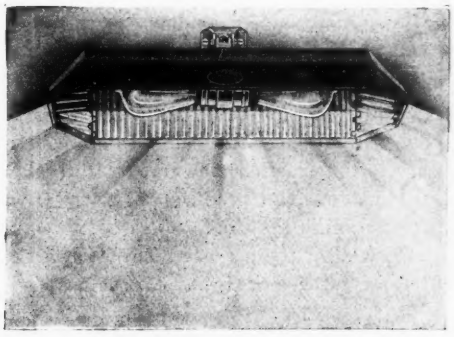


FIG. 2.—FRONT VIEW, PANELED-END REFLECTOR.

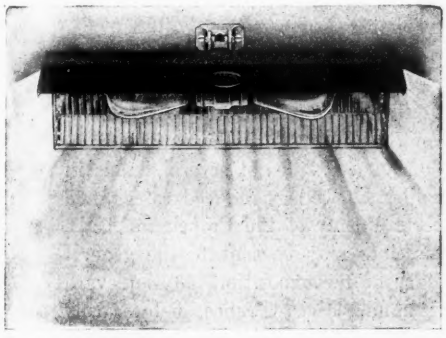


FIG. 3.—OPEN-END REFLECTOR.

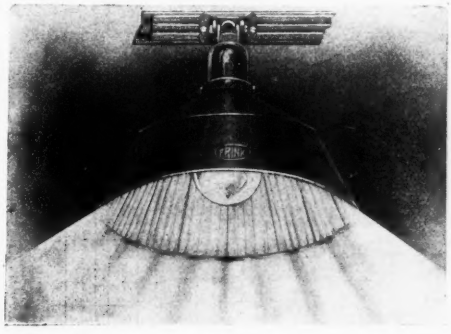


FIG. 4.—ROUND REFLECTOR.

FIG. 5.—REFLECTOR FOR HIGH SHOW-CASES.

The metal protection obviates the possibility of scratching the silvering, and any glass broken by accident can be easily replaced. The reflectors are adjustable to any size of window, high or low, and can be attached to window frame or ceiling with flexible cord feed or connected direct to the molding, conduit or condulet. With this system there is no exposed wiring.

Fig. 1 shows an end view of the paneled-end reflector fifteen inches long. Fig. 2 shows the front view of the same reflector. Fig. 3 shows the plain open-end reflector fifteen inches long. Fig. 4 shows a round reflector twelve inches in diameter for tungsten, tantalum or high-efficiency lamps. Fig. 5 shows a reflector for high show-cases. This reflector can be connected direct to condulet, conduit or junction box. This is the same as the reflector shown in Fig. 3, but is much smaller. It is made for standard or tubular lamps.

FIG. 6.—ADJUSTABLE FITTING FOR CONNECTING DIRECT TO CONDUIT.

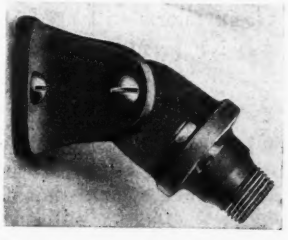


FIG. 7.—ADJUSTABLE FITTING FOR CONNECTING TO MOLDING.

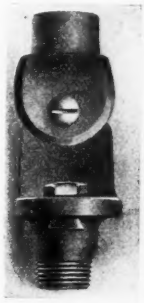


FIG. 8.—ADJUSTABLE FITTING FOR USE WITH LONG OR SHORT STEM.

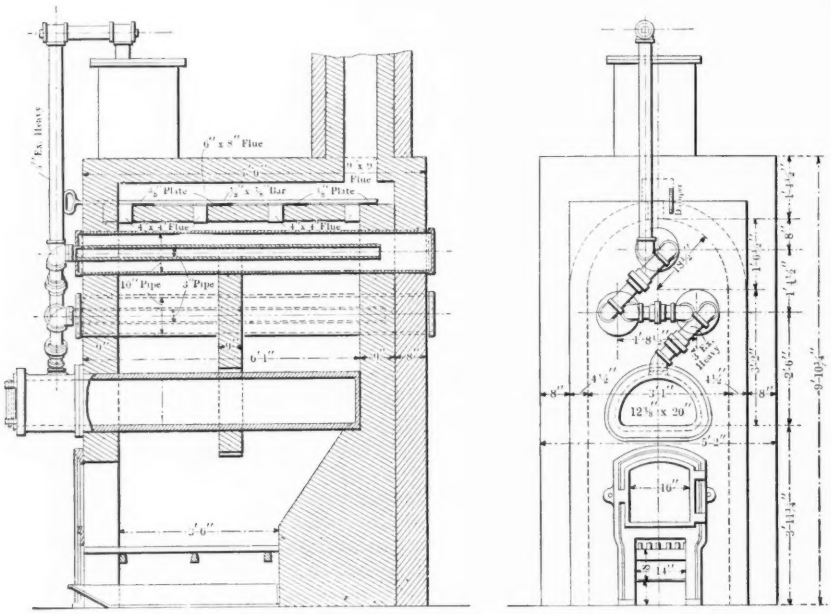
Fig. 6 shows the special adjustable fitting for connecting direct to the conduit, condulet or junction box. Fig. 7 shows the special adjustable fitting for connecting direct to the molding. This may also be used on window frames or ceiling with flexible cord feed. Fig. 8 shows a special adjustable fitting for using a long or short stem.

## Lectures on Railroad Electrification at the University of Michigan.

C. L. de Muralt, consulting engineer and professor of electrical engineering at the University of Michigan, is giving a course of lectures to the senior electrical engineering students at Ann Arbor on the "Electrification of Steam Railroads." Professor Muralt, who has been lecturing during the last semester on the underlying phases of this subject, such as the power-station equipment, transmission and working conductors, motor characteristics, etc., intends to supplement these by a discussion of the technical and commercial features of the following subjects: (1) "The General Electrification Problem," (2) "The Reasons for Electrification," (3) "The Operating Characteristics of Steam and Electric Locomotives," (4) "The Choice of Electric Systems," (5) "The Analysis of the Cost of Operation," (6) "The Field of Railroad Electrification: The Congested Terminal, the Mountain Grade, and the Trunk Line," and (7) "Preparation of an Electrification Project for a Particular Road," special attention being directed to such problems as the design of locomotives, the calculation of run sheets, the choice of speeds, study of the peak load, the location of substations, the economics of transmission and other collateral topics.

## Producing Illuminating and Power Gas from Waste Products.

A very interesting demonstration of the Harris gas process of utilizing garbage, street sweepings, peat, sawdust and other waste products, converting all such refuse into a high illuminating and power gas, is being carried out at a demonstrating plant at 197 Vanderpool street, Newark, N. J. This system, the invention of L. G. Harris, of Orange, N. J., bids fair to practically revolutionize the present-day methods of disposing of the waste products of large and small cities. The accompanying illustration shows a transverse section and an elevation of the bench




Gas Bench Used in Making Illuminating Gas from Refuse by the "Harris" Process.

which is being used by Mr. Harris to demonstrate the utility of his process.

Street sweepings, garbage, peat, sawdust or other waste products are spread upon shallow metal troughs and sprinkled with a chemical solution composed mainly of alkalies. The receptacle is placed in the ordinary D-shaped retort and brought to a heat of about 1,200 degrees Fahrenheit. The gases evolved by the decomposition of the waste material are passed through superheaters which form a part of the bench proper, and then through condensers, scrubbers and purifiers into a gasometer of large proportions. The gas evolved in its purified state has apparently a high illuminating power, estimated to be about double the candle-power of ordinary coal or water gas, and contains for power purposes about 800 heat units.

The Harris process produces 15,000 cubic feet of gas per ton of refuse, and the gas is made much more rapidly than from coal. Ten gallons of the chemical mixture are added to a ton of garbage, and the cost of this chemical does not exceed fifty cents to treat each ton. The time required to produce a large volume of gas is less than half that required to produce the same volume from coal, and by means of the chemicals and through the agency of the process employed the final distillation is held back so that, contrary to the experience observed with coal gas, the final run produces a better gas than the initial heating.

After all of the gas has been generated from the garbage the residue or ash, which amounts to about ten per cent of its original weight, may be used as a valuable fertilizing material, containing cyanides of potash and other constituents found in high-grade fertilizers. The tar and ammonia saved are also valuable by-products.

As far as the fuel cost is concerned, it has been determined that a Fleming gas bench of six retorts will use in twenty-four hours 1,500 pounds of coke for fuel and carbonate 10,800 pounds of coal, producing 48,400 cubic feet of gas. Six retorts it is stated using the same quantity of coke in twenty-four hours carbonates 31,200 pounds of garbage, peat and other refuse, and produce approximately 252,000 cubic feet of gas. With six or ten retorts, however, working at their full efficiency, it would be unnecessary to use coke for heating, as sufficient heat could be produced from one-third of the gas evolved to furnish all the heating necessary for the carbonating of the material.

## International Exhibition of the Applications of Electricity.

At the International Exhibition of the Applications of Electricity, to be held at Marseilles, France, from April 19 to October 31, an international congress will take place between September 14 and September 21. The congress will have as honorary presidents: E. E. N. Mascart, member of the Institute, president of the Permanent Committee of Electricity; A. D'Arsonval, member of the Institute, professor of the College de France; Marcel Deprez, member of the Institute; Hippolyte Fontaine, electrical engineer. The president of the congress will be Maurice Levy, member of the Institute, inspector-general of bridges and ways, professor at the College de France and the École Centrale, vice-president of the Permanent Committee of Electricity. The vice-president is Paul Janet, professor at the Paris University, director of the Central Laboratory and the École Supérieure d'Electricité.

This congress will have general meetings, section meetings, lectures and visits to industrial establishments. The members of the congress will have the advantage of reduced rates at several hotels in Marseilles, as well as reduced rates when traveling on any of the French railroads. Manuscripts may be sent to the general secretary of the exposition, 63 Boulevard Haussmann, Paris, France, before July 15. The admission fee to the congress will be twenty francs. Checks or money orders may be made payable to M. le Trésorier du Congrès, 63 Boulevard Haussmann, Paris.

The following programme has been announced:

SECTION I—REGULATION.

Report on the comparison of French legislation with similar laws of foreign countries.

Report on the arrangement of crossings of electric lines over roads, railroad tracks, telegraph, telephone and signal lines.

Report on accidents involving outside parties, and methods of warning the public and school children against the dangers of electric transmission lines and the possible results of breaking of insulators, supports, etc.

Report on the question of taxes and franchises of electrical distributing systems.

SECTION II—CONSTRUCTION AND PROTECTION OF ELECTRICAL SYSTEMS.

General report on insulators.

Report on commercial insulating material.

Report on different types of supports for overhead lines.

Report on overhead conductors.

Report on underground cables.

Report on protective arrangements in case of breaking of overhead conductors.

Report on the protection of electrical systems against sudden rises of potential.

SECTION III—TECHNICAL AND COMMERCIAL OPERATION.

Report on the comparison of different methods of transmitting electrical energy.

Report on the use of storage batteries in connection with electrical distributing systems.

Report on the use of the earth as part of a circuit.

Report on the technical operation of transmission and distributing systems of electrical energy (patrolling and maintenance of lines, protection of employés, regulation, etc.).

Report on disturbances caused by electric light or power lines in telephone circuits carried on the same poles.

Report on different methods of selling electrical energy.

Report on wattmeters.

Report on the insurance of electrical systems.

SECTION IV—LIGHTING AND DOMESTIC APPLICATION.

Report on the methods of electric lighting.

Report on specifications and photometry of electric lamps.

Report on electric heating.

SECTION V—APPLICATIONS TO INDUSTRY, MINES, TRACTION AND AGRICULTURE.

Report on the use of electrical energy in workshops and factories.

Report on the economical and social consequences of the use of electrical energy at home.

Report on automatic electric regulators and control motors.

Report on the electrical equipment of mines.

Report on the comparison of the different systems of electric traction.

Report on the applications of electric traction to railroads.

Report on operating results of the different metropolitan railroad systems.

Report on the testing of electric traction material.

Report on signal and switching systems for railroads.

Report on the use of electrical energy for drainage and irrigation.

Report on electromechanical culture of the soil.

SECTION VI—ELECTROCHEMISTRY AND ELECTROMETALLURGY.

Report on the fixation of atmosphere nitrogen.

Report on the present state of electrometallurgy.

Report on the present state of electrochemistry.

Report on the preparation of colloids.

SECTION VII—TELEGRAPHY AND TELEPHONY.

Report on wireless telegraphy.

Report on wireless telephony.

Report on the present state of telephony.

Report on the present state of submarine telegraphy.

Report on the present state of high-speed telegraphy.

Report on the present state of telemechanic.

SECTION VIII—TEACHING AND MEASURES.

Report on electrotechnical schools.

Report on what the electrical engineer must be.

Report on the existing measuring instruments and the organization of an industrial laboratory.

Report on the responsibility of technical schools in cases of accidents to students or accidents caused by students.

SECTION IX—APPLICATIONS TO HYGIENE AND MEDICINE.

Report on the treatment of persons injured by contact with electrical systems.

Report on the sterilization of water and air by electrical processes.

Report on measuring instruments for radiotherapy.

Report on meters for radiography and radiotherapy.

Report on the production of large currents and currents of high frequency and their use in medicine.

Report on the destructive action of the electric spark on human tissue.

Report on Crookes tubes of large capacity.

## Wire Inspection Service.

The Wire Inspection Bureau has issued a circular letter explaining its attitude with relation to the position assumed by the Underwriters' Laboratories. The letter is as follows:

"The committee appointed by the several manufacturers of approved rubber-covered wires, and the secretary of the Wire Inspection Bureau, attended a conference in this city on Thursday, March 5, at which conference were present the chairman and several members of the executive committee of the National Board of Fire Underwriters, the secretary and other representatives of the Underwriters' National Electric Association, the president and other representatives of the Underwriters' Laboratories and all the gentlemen heretofore composing the committee on finance and specifications of the Wire Inspection Bureau. This meeting was arranged to consider the circular letter issued from Chicago on February 15, 1908, by the Underwriters' Laboratories, in which the statement was made that they could not longer indorse the label service of the Wire Inspection Bureau. It was promptly made plain by the several representatives of the insurance interests of this country that they had no desire to harm or injure in any way the manufacturers, but rather were exceedingly anxious to work harmoniously with them in a joint effort to establish a high standard of manufactured product and insure that all product sold should be kept up to such a standard.

"On behalf of the manufacturers, it was explained that it would not be satisfactory to many or all of them to admit into their works inspectors exclusively under the employ of the Underwriters' Laboratories or any other organization in the management or control of which they had no voice. It was stated that the Underwriters' Laboratories had no desire to force on the manufacturers a stamp or label service, and it would go no further than to offer such service if it was desired by the manufacturers. After fully considering the matter from all standpoints it was decided that the manufacturers themselves can supervise the inspection and labeling of wire, and that their united indorsement of any system would answer every purpose. As the committee who represented the manufacturers at this conference had full power to act, the matter may be considered as finally arranged. The Wire Inspection Bureau will continue the work which it has carried on in the past, with only such improvements as may be suggested from time to time by the Underwriters' Laboratories, the manufacturers themselves or any other parties interested. It is understood that the laboratories will continue to approve all makes of wire, provided same come up to the requirements of their specifications, and that all approved wires shall be regularly listed by the laboratories in their periodical publications. The Wire Inspection Bureau will only give label service to the manufacturers who are producing an approved wire. The labels or stamps used will be a certification by the united manufacturers that any wire bearing such stamps is fully up to the Underwriters' Laboratories standard. We purpose, as soon as possible, securing the indorsement of this label service by other interests in the United States, and as we progress along these lines will keep you promptly advised."

# Current Electrical News

## DOMESTIC AND EXPORT.

CHICAGO RAILWAYS COMPANY—Permits for rehabilitation which will cost about $600,000 have been taken out by the Chicago Railways Company. The permits are for the laying of fifteen miles of new track, to cost $40,000 a mile. Work has already been begun.

PROPOSED NEW ELECTRIC LINE—It is announced that a syndicate with a capital of $1,000,000 has been formed to build a trolley road from Lewes, Del., to Rehoboth, Del., and Ocean City, Md. Rehoboth Bay will be crossed either by a bridge or by ferry. The promoters are said to be Philadelphia and Wilmington capitalists. It is understood many subscriptions for the stock have already been received and that it is proposed to begin work this spring.

NEW ELECTRIC COMPANY FORMED—To bid for business in Jersey City, N. J., and adjacent towns at first, and afterward in other parts of the state, the Mutual Benefit Electric Light and Power Company has filed articles of incorporation with the county clerk of Hudson County with a capital of $2,500,000. The incorporators are James M. Seymour, president of the Block Lighting Company; Jean R. Blinck, Richard S. Carrick and John F. Nagel, of Jersey City. The new company will also offer to establish lighting plants in municipalities, agree to sell current at a uniform and low rate for twenty years, and then turn the plant over to the municipality at an appraised value of its machinery in its then condition. The new company will have offices in the Commercial Trust Company Building, Jersey City, and will at once apply for privileges in that city to supply current to several blocks where business is already pledged to the concern. Construction of the various block-lighting systems will begin immediately and negotiations for franchises in several suburban towns are being carried on.

WASHINGTON WATER POWER COMPANY TO IMPROVE SYSTEM—The Washington Water Power Company plans to expend this year $1,000,000 in improvements and extensions. A line is now under construction from Medical Lake to Lind, Wash., while extensions are projected in the Cœur d'Alenes and in the Palouse country. To meet these expenses the company has sold $3,000,000 of six per cent three-year gold coupon notes, of which $2,000,000 will be used to retire an equal amount of outstanding notes due July 1, 1908, and $1,000,000 toward the new improvements. The $2,000,000 notes to be retired bear five per cent, while the new issue bears six per cent, and the holders of the old notes are to have the privilege of exchanging them for the new. The new notes are junior to an issue of $1,600,000 five per cent bonds due in 1929, and contain a provision that no second mortgage shall be placed on the property until the notes are retired. July 1, 1908, at the issuance of the refunding notes, the capital of the Water Power Company will appear about as follows: Stock at par, $5,010,500; three-year notes, $3,000,000, and five per cent bonds, $1,600,000; total, $9,610,500.

MEXICAN LIGHT AND POWER COMPANY—The annual report for 1907 of the Mexican Light and Power Company shows that during the year there was expended on capital account a total of $2,475,331.73, gold, of which over $1,000,000 was expended in the work of completing the first Necaxa installation, approximately $1,000,000 on distributing lines and equipment in the city and Federal District of Mexico and approximately $350,000 on the works of the second installation, which cost $688,000, gold, to December 31, 1907. The Laguna dam has now been raised to a height that will provide a storage capacity of 30,000,000 cubic metres of water. The construction of the provisional dam at Los Reyes and the tunnel connecting the Laguna reservoir with that of Los Reyes progressed satisfactorily throughout the year. The construction of the large dam at Necaxa, which necessitates the deposit of 1,634,000 cubic metres of material, is proceeding slowly, but on the whole satisfactorily. On December 1, 1907, 337,000 cubic metres of material had been deposited, and the work is now proceeding at the rate of 73,000 cubic metres of material per month. The company has now in sight additional contract for supplying installations representing motors of over 3,000-horse-power capacity, exclusive of the contract already made with the federal government—approximately 3,000 horse-power—for the purpose of providing potable water for Mexico City, which supply will probably commence late in the present year as soon as the government has so far completed its works as to avail itself of this contract.

## NEW PUBLICATIONS.

TERRESTRIAL MAGNETISM—A report is given of the results of magnetic observations made by the United States Coast and Geodetic Survey between July 1, 1906, and June 30, 1907, by R. L. Faris, inspector of magnetic work and chief of the division of terrestrial magnetism of the Coast and Geodetic Survey. This outlines briefly the work done at the different magnetic observatories in the country, of which there are 254. During the year observations were also made at sea, there being two vessels employed on the Atlantic seaboard and one on the Pacific.

"RUBBER TRADE DIRECTORY"—The "Rubber Trade Directory" for 1908 has just been issued. This contains a list of the trade organizations in the country, giving their officers, the rubber statistics of the leading countries for the past ten years, a synopsis of the prices for crude rubber at New York, and a directory of the manufacturers and dealers in india-rubber and gutta-percha goods and the allied lines in the United States, arranged according to states. This volume has also a list of trade-marks, trade names, and brands for india-rubber goods, and an abstract of some of the laws relating to the use of trade-marks and the status of foreign corporations in the several states. The directory is published by the *India Rubber World*, 395 Broadway, New York city.

TRANSACTIONS OF THE AMERICAN ELECTROCHEMICAL SOCIETY—Volume xii of the transactions of the American Electrochemical Society, containing a report of the twelfth general meeting, held in New York city, October 17, 18 and 19, 1907, has been issued. This volume contains all the papers and discussions of that meeting. It is somewhat larger than recent volumes of the transactions, containing 478 pages. In it will be found a directory of the members of the society, the two lectures delivered during the recent meeting, one by E. G. Acheson on "Deflocculated Graphite," the other by G. F. Kunz on "Diamond and Moissanite: Natural, Artificial and Meteoric." In addition to these there are twenty-three papers. Among the most important of these are "The Mathematics of the Induction Furnace," by Gustav Gin; "The Heat Conductivity of Carbon," by F. J. J. Fitzgerald; "Silicon Monoxide," "Monox," and the "Production of Monox"—three papers—by Henry Noel Potter, and a further contribution to the "Study of Concentration Cells," by H. S. Carhart and F. J. Mellencamp.

TERRESTRIAL MAGNETISM—The report of Dr. L. A. Bauer, director of the department of terrestrial magnetism at the Carnegie Institution, Washington, D. C., for the year 1907, has been issued. This describes the magnetic survey which is being made of the Pacific Ocean by means of the yacht Galilee. At the close of the year 1906 the Galilee had returned to San Diego, Cal., and on December 22 of that year she set sail from that port upon the third cruise in the Pacific. This carried her south to the Society Islands, thence to Samoa, through the Carolina Islands up to Shanghai, then northeasterly to Sitka, Alaska, thence to Honolulu. The Galilee left Honolulu on September 26 and sailed to Jaluit, Marshall Islands. She is still on this voyage, which will be completed some time in the present year. During the year magnetic surveys were also made on land areas, including Alaska, Bermuda Islands, Canada, Central America, China, Mexico and Southern Pacific Islands. During the voyage of the Galilee magnetic observations were made at various depths at sea and a survey on the local magnetic pole at Treadwell Point, Alaska.

## PERSONAL MENTION.

MR. HARVEY W. HARPER, president of the Howard Miniature Lamp Company, Newark, N. J., has returned from a visit to his home in London, England.

MR. FRANK F. FOWLE, Chicago, Ill., announces the opening of his office as consulting electrical and telephone engineer in the Marquette Building, 204 Dearborn street, Chicago.

MR. E. J. COYLE has resigned as manager of the Southern Electrical Company, of Baltimore, Md., and associated himself with the Baltimore Electrical Supply Company as sales manager.

MR. WILLIAM MARCONI has been elected manager of the Marconi Wireless Telegraph Company, and will maintain headquarters in London. He succeeds H. Cuthbert Hall, resigned.

MR. HARRY SHANNONHOUSE, who has been manager of the Southern Bell Telephone exchange at Burlington, N. C., for some time, has resigned, and R. F. Durant, of Charlotte, has succeeded him.

MR. H. E. PLASS, of the Howard Miniature Lamp Company, Newark, N. J., has been granted a patent for a receptacle that can be instantly attached to flexible cord for use with miniature multiple or series lamps.

MR. GEORGE W. HUTCHINSON has been appointed assistant to the chief engineer of the Virginia Passenger and Power Company, Richmond, Va., by the receivers. Mr. Hutchinson was formerly mechanical engineer at the Old Dominion Iron and Nail Works, and also of the Richmond branch of the American Locomotive Works. He is a graduate of the Virginia Polytechnic Institute.

MR. W. T. GODDARD, electrical engineer of the Locke Insulator Manufacturing Company, Victor, N. Y., is making an extensive trip through the western states and through the Pacific Coast states, investigating high-voltage insulator applications and transmission-line and power-house design. Mr. Goddard is making a special study of the influence of various climatic conditions upon the design of insulators for various localities, especially in view of designs for 100,000 volts and higher.

MR. LESTER G. FRENCH has been appointed to direct the editorial department of the American Society of Mechanical Engineers. Mr. French was born in Keene, N. H., in 1869, and following an early training in editorial work and printing at Brattleboro, Vt., received his degree in mechanical engineering from the Massachusetts Institute of Technology in 1891. After four years' apprenticeship, drafting room and shop experience, principally at the Builders' Iron Foundry Shops, in Providence, R. I., and a year and a half as a text-book writer, he was engaged on the editorial staff of *Machinery*. For nine years he was editor-in-chief of that paper. Recently Mr. French re-engaged in the publishing of text-books on algebra, applied mechanics, and of a treatise on steam turbines.

## OBITUARY NOTES.

MR. P. H. ALEXANDER, one of the old-time electrical representatives, died at Nyack, N. Y., on Saturday, March 21. Mr. Alexander was prominently identified, in the early days of the incandescent lamp industry, with the Sawyer-Man Electric Company and the Westinghouse Electric and Manufacturing Company. He later organized the firm of Alexander, Barney & Chapin. He subsequently became connected with the Southern Electrical Company, of Baltimore, Md., and spent several years in government construction work in the District of Columbia and Virginia. He has not been active in the electrical field for some time. He was in his sixtieth year and had a large number of friends and acquaintances in the industry.

MR. ADDISON F. HUNIE, secretary and treasurer of the United Illuminating Company, New Haven, Ct., died on March 13 at his home in New Haven. Mr. Hunie was forty years of age. He was a graduate of the Hillhouse High School. After he left school he went into the employ of what was then the New Haven Electric Light Company when that concern was in its infancy. His first service was as office boy. He was promoted to clerk and in 1889 was elected secretary and treasurer. His faithfulness and efficiency won for him rapid promotions. Mr. Hunie is survived by a widow and three children.

## ELECTRICAL SECURITIES.

There has been little gain made over the high point reached in the stock market over a week ago. At the same time, whenever there has been any offering of securities, it has been taken up liberally. Continued improvement follows each assurance of stability in business, and although the number of unemployed is very great, it is expected that this will diminish as the days go on. Already there is considerable ease in the money market, with evidences of cash available for legitimate enterprises.

Dividends have been declared upon the following electrical securities: Cincinnati (Ohio) Street Railway Company; regular quarterly dividend of 1½ per cent, payable April 1. Rochester (N. Y.) Railway Company; regular quarterly dividend of 1¼ per cent on the preferred stock, payable April 1 to stock of record March 25. Massachusetts Lighting Companies; regular quarterly dividend of 1½ per cent, payable April 15 to stock of record April 1. Bell Telephone Company of Pennsylvania; regular quarterly dividend of 1½ per cent, payable April 15 to stock of record on April 4. Washington Water Power Company, Spokane, Wash.; regular quarterly dividend of 1¾ per cent, payable April 1 to stockholders of record March 20. Havana (Cuba) Electric Railway Company; regular quarterly dividend of 1½ per cent, on the preferred stock, payable April 15. Books close March 31 and reopen April 16. United Railways of St. Louis; regular quarterly dividend of 1¼ per cent on the preferred stock, payable April 10.

ELECTRICAL SECURITIES FOR THE WEEK ENDED MARCH 21.

| *New York:* | *Closing.* |
|---|---|
| Allis-Chalmers common | 7½ |
| Allis-Chalmers preferred | 20 |
| Brooklyn Rapid Transit | 46⅞ |
| Consolidated Gas | 102½ |
| General Electric | 122½ |
| Interborough-Metropolitan common | 7 |
| Interborough-Metropolitan preferred | 18½ |
| Kings County Electric | 92 |
| Mackay Companies (Postal Telegraph and Cables) common | 55 |
| Mackay Companies (Postal Telegraph and Cables) preferred | 61 |
| Manhattan Elevated | 120 |
| Metropolitan Street Railway | 15½ |
| New York & New Jersey Telephone | 98 |
| Western Union | 48 |
| Westinghouse Manufacturing Company | 41 |

| *Boston:* | *Closing.* |
|---|---|
| American Telephone and Telegraph | 108½ |
| Edison Electric Illuminating | 202 |
| Massachusetts Electric | 45 |
| New England Telephone | 109 |
| Western Telephone and Telegraph preferred | 62½ |

The American Telephone and Telegraph Company made an increase in gross earnings in the first two months of the current year of $1,171,267, or 24.8 per cent. After deducting expenses and interest charges the surplus for the stock was increased $968,475, or 29.31 per cent. The surplus of $4,271,105 equals 2.8 per cent on the $152,460,000 stock outstanding. The earnings for the two months are: Total earnings, $5,893,257; expenses, $341,211; net earnings, $5,552,046; deduct interest, $1,280,941; surplus, $4,271,105, an increase of $968,475.

At the annual meeting of the Western Telephone and Telegraph Company Moses Williams was elected a director to succeed James J. Storrow, resigned, and Alexander Cochrane was elected to fill the vacancy caused by his own resignation early last year.

| *Philadelphia:* | *Closing.* |
|---|---|
| Electric Company of America | 9 |
| Electric Storage Battery common | 25 |
| Electric Storage Battery preferred | 25 |
| Philadelphia Electric | 7¾ |
| Philadelphia Rapid Transit | 18⅝ |
| United Gas Improvement | 79 |

| *Chicago:* | *Closing.* |
|---|---|
| Chicago Telephone | 119 |
| Commonwealth Edison | 89½ |
| Metropolitan Elevated preferred | 49 |
| National Carbon common | 52½ |
| National Carbon preferred | 102½ |

The directors of the Chicago Telephone Company have declared the regular quarterly dividend of 2½ per cent, payable March 31.

Directors of the National Carbon Company have declared the regular quarterly dividend of 1 per cent on the common stock, payable April 15. Books close April 4 and reopen April 16.

## ELECTRIC RAILWAYS.

SALEM, ORE.—Work has been commenced on the Portland, Eugene & Eastern electric road at Eugene, Albany and Springfield.

ASHEVILLE, N. C.—Preliminary work has been started on the proposed Asheville-Hendersonville electric railway, and several large crews are now engaged surveying the route.

VICKSBURG, MISS.—Chancellor Hicks has ordered that the property of the Vicksburg Street Railway Company be sold the first Monday in May to satisfy the judgments of Sarah Bullis *et al.* against it.

MASSILLON, OHIO—The contract for the construction of the Massillon, Wooster & Mansfield electric railway has been let to the Frank Ovens Company, and the Mohawk Construction Company, of Boston.

CLARKSBURG, W. VA.—Fire, on March 7, destroyed the power-house of the Fairmont & Clarksburg Traction Company, at Adamston, with a loss of $38,000. For the present connection will be made with the high-tension line from Fairmont.

FORT COLLINS, COL.—It is announced that work will be commenced at once on six miles of extension of the Denver & Interurban line. The road will be constructed to two summer resorts and will be extended three miles south of the city.

MILWAUKEE, WIS.—The Fidelity Trust Company of Milwaukee has been appointed by Judge Tarrant as receiver in Wisconsin for the Chicago & Milwaukee Electric Railway Company. The receiver was appointed on the application of the Columbia Construction Company.

SALINA, KAN.—At a meeting of the Commercial Club a stock company was organized with a capital stock of $100,000 for the purpose of constructing an interurban railway to connect several towns in Central Kansas. Several persons have volunteered to promote interurban lines in this part of the state.

KANSAS CITY, MO.—Work has been begun on the extension of the electric car line from Merriam to Shawnee, Kan. The line was finished as far as Merriam, Kan., several months ago. Cars have been running over that part of the line since Christmas. The distance from Merriam to Shawnee that remains to be completed is about one mile.

SHERIDAN, WYO.—S. A. Broadwell, representing Eastern capitalists, is negotiating with the city council for a street railway franchise, and promises to have a part of the line in operation next fall, if granted a franchise. The plan contemplates connecting the large coal camps with the city. These camps employ more than 5,000 men.

HAMPTON, N. H.—The Exeter, Hampton & Amesbury Street Railway Company has been sold at public auction for $250,000 to Charles H. Penny, of Hartford, Ct., who represented a committee of the bondholders of the company. Mr. Penny was the only bidder. The road has been in operation for several years, but recently the financial returns have been unsatisfactory and a sale was decided upon.

BROWNSVILLE, TEX.—The city council has granted a franchise for a street railway to the following persons: John G. Fernandez, A. C. Brokaw, F. W. Kibbe, S. K. Hallam and L. H. Hallam, all of Brownsville. The franchise gives the grantees the right to build on all streets and alleys of the city. The franchise is for twenty-five years. The company is required to begin work within twelve months and have two miles of road built and in operation within two years.

RIVERSIDE, CAL.—An operating agreement between the Huntington trolley interests and the Crescent City Railway Company has been effected by which the Riverside & Arlington Railway will operate over the line now being equipped by the Crescent between Riverside and the plant of the Southern California Cement Company at Crestmore. Under the terms of this agreement the Crescent City company, an allied corporation with the cement company, is to complete the electrifying of the freight line completed several months ago and turn it over ready for operation by the Huntington company. This will give the Huntington company another link in its line to Los Angeles.

AUGUSTA, GA.—The Atlanta & Carolina Railway Company, which intends building a trolley line from Atlanta to Augusta and possibly on to Columbia, S. C., has had its charter amended so as to give it authority to enter several counties not included in the original charter and to make use of streets in several important Georgia towns. The new counties included are: Newton, Columbia, Richmond, Lincoln, Walton, Oconee, Clarke, Oglethorpe, Wilkes and McDuffie.

GREENCASTLE, PA.—The Chambersburg, Greencastle & Waynesboro Street Railway Company has awarded to the J. G. Schaff Electric Company a contract for additional equipment to be installed at Waynesboro and at its proposed substation at Marion. Between the power-house and substation building at Marion will be erected a modern three-phase transmission line for the transmission of 23,000-volt current. This line will be erected along the present right of way on the existing pole line.

JACKSONVILLE, TEX.—H. L. Norton, of Boston, Mass., has submitted an electric interurban proposition to the citizens. Morton represents large interurban capital in the East and proposes to build and equip a line seventy-five miles long to connect Jacksonville, Dialville, Rusk and Tyler, with spur tracks every three or four miles, upon which five-ton, four-wheel cars will be run for accommodation of truck growers. He asks no stock subscriptions, only right of way, etc. The line will be built entirely by Eastern capital and principally for freight in the truck and fruit trade.

FORT PLAIN, N. Y.—The Mohawk Valley Improvement Company has been formed at Fort Plain, presumably to construct a trolley line between Little Falls and Tribes Hill, to connect the Utica & Mohawk Valley line with the Fonda, Johnstown & Gloversville system. The company has a capital stock of $6,000, and the officers are: President, Thomas J. Zoller, Little Falls; vice-president, Frank Gebbie, St. Johnsville; secretary-treasurer, Abram Devendorf, Fort Plain. The other directors are: Elmer E. Folmsbee, Fonda; E. P. Burnap, Canajoharie; A. M. Farnam, Cooperstown; H. E. Hartwell, New York; Bartlett Arkell, Canajoharie.

NEW HAVEN, CT.—It is stated by an officer of the Shore Line Electric Railway, which has a charter for a trolley road from Stony Creek to the west side of the Connecticut River, that the line will probably be opened for traffic this summer. Much of the grading work has been done along its proposed route. The shore line trolley will run from Saybrook to Ivoryton and to Essex if the present plans of the company are carried out. In connection with the progress being made by the Shore Line in completing its proposed line a charter has been granted to a company to build a trolley from East Lyme to the easterly side of the Connecticut River which will make a continuous trolley paralleling the Shore Line division of the New Haven road.

EVANSVILLE, IND.—The Evansville Terminal Railway Company, whose primary purpose is to construct ten miles of track from Evansville to Newburgh, to connect with the Evansville & Eastern line at the latter point, has filed articles of incorporation. The capital stock is placed at $200,000. It is said that the new company will parallel the Evansville, Suburban & Newburgh tracks most of the way. The incorporators are: A. F. Karges, M. S. Sonntag, W. H. McCurdy, James V. Rush, Fred W. Reitz, William A. Koch, Louis A. Daus, A. P. Lahr, Charles F. Hartmetz, Evansville; Charles W. Brizius and Wesley Wilson, Newburgh. All of these men are the directors in the Evansville Railways Company, the corporation which owns the Evansville & Mt. Vernon and the Evansville & Rockport lines.

ALBANY, N. Y.—The Albany & Hudson Company is ready to build its twenty-two miles of connection from Nassau to the state line before October 1, and offers to spend $35,000 on Lebanon Mountain, according to agreement, before May 1, preparing for the connection of the Pittsfield road, and will contract to build this season its six miles of connecting road from West Pittsfield to the state line. Sperry & McLaine, New Haven engineers, have made the surveys, plans and estimates. The road will cost about $1,000,000 and will run from Nassau through the following townships: East Nassau, Brainard, West Lebanon, New Lebanon, Lebanon Springs and Hancock. It is estimated that the six miles of connection of the Pittsfield road up Lebanon Mountain will cost $50,000 a mile. The route follows along the state road over Lebanon Mountain.

## ELECTRIC LIGHTING.

TABOR, TENN.—The people of Tabor have decided to organize an electric light company with a capital of $10,000.

COLEBROOK, N. H.—The W. E. & W. Drew Electric Light Company has passed into the control of West Stewartstown men.

JUNEAU, ALASKA—The city council has granted a franchise to the Juneau Electric Light Company for a term of fifty years.

OMAHA, NEB.—Plans have been made by the Omaha Electric Light Company for a new transformer house, which will cost $5,000.

LAKE CRYSTAL, MINN.—The electric light plant at Lake Crystal has been purchased by C. S. Christenson & Company, of Madelia.

CHILTON, WIS.—The voters of this city will, at the coming spring election, decide whether the city shall own and operate its electric lighting plant.

MONROE, WIS.—The Monroe Electric Light and Power Company has been awarded a ten-year contract for street lighting. The rate will remain as heretofore, $65 a lamp per year.

CHEYENNE, WYO.—State Engineer Johnston has announced that the height of the dam of the Big Horn Power Company, in the cañon of the Big Horn River, will be limited to thirty-five feet.

LUDLOW, MASS.—The Ludlow Manufacturing Associates have issued a notice to their electric light consumers of a reduction of twenty-five per cent in the rate charged for service, the new rate being twelve cents per kilowatt-hour to all consumers.

LEETONIA, OHIO—The People's Electric Light and Power Company, to manufacture light, heat and power for Leetonia and Columbiana County, has been incorporated with a capital stock of $15,000 by Albert E. Green, Alison J. Thompson, John M. Garfield, E. J. Blandins and Frank H. Cinn.

OGDEN, UTAH—A new power plant to cost approximately $50,000 will be erected near Willard Cañon by M. S. Browning and his brother, J. M. Browning, who have completed a deal for all of the water rights in Willard Cañon. When the plant is completed power will be conveyed into Ogden by high-power lines.

LIMA, OHIO—The city council has voted to issue bonds for $80,000 for the building of a municipal electric light plant. The city council proposes to accept the estimates made by E. R. Young, of Toledo, who agrees to construct the plant at the price named with sufficient capacity for commercial and private consumption.

ST. LOUIS, MO.—The Light and Development Company, a corporation formed by former employés of the Laclede Power Company, has been incorporated with a capital stock of $5,000. The incorporators are: W. A. Smith, E. M. Kurtz, H. W. Beck and Hugh Murdock. The object of the company is to distribute light, heat and power.

ST. LOUIS, MO.—The Light and Development Company, a cor- is to be increased by the installation of a new 1,000-kilowatt generator. Street lights for the entire West Side will be supplied from the municipal plant, and service furnished to homes. A transfer of $37,000 has been made from the general contingent fund to enable the board of public works to contract for new machinery.

RUMNEY, N. H.—A new stock company is to be formed in the town of Rumney for the purpose of establishing an electric lighting plant. The town has voted to secure electric lights of the new company for a term of not less than five and not more than ten years at an annual rental of $500. Stinson Brook will be the power source. The town will begin with a contract of sixty-five incandescent lights for the streets.

GLENDORA, CAL.—The Glendora Light and Power Company has been organized with a capital of $20,000, and the following officers: J. A. Jones, president; H. G. Baker, vice-president, and C. S. Whitcomb, secretary-treasurer. A sufficient amount of stock has been subscribed and paid up to enable the company to begin operations at once, and it is believed that a complete light and power plant can be installed in sixty days.

TAYLOR, TEX.—Plans are rapidly being formulated for installing a contemporary electric light company here, which, it is rumored, will be in operation within ninety days. It is composed of local capitalists, as a result of dissatisfaction over the present meter rates and flat rates. It is said the new company will reduce the price of service from the present scale of twenty cents per 1,000 watts to ten cents per 1,000. The names of the promoters are not given.

LACONIA, N. H.—At the annual meeting of the Laconia Electric Lighting Company the following officers were elected for the coming year: President, W. L. Mauran, Providence, R. I.; vice-president, J. P. Mauran, Providence; treasurer, Thomas E. Stere, Providence; clerk, F. M. Beckford, Laconia; manager, F. L. Thomas, Laconia; directors, W. L. Mauran, J. P. Mauran, F. M. Beckford, T. E. Stere, F. L. Thomas and Edmund Little. The reports showed that the financial condition of the company was most excellent.

TRENTON, N. J.—Vice-Chancellor Walker has appointed Mitchell B. Perkins temporary receiver of the Bordentown Electric Light Company and the Cinnaminson Electric Light Company. The receivership application was made by Whitney & Kemmerer and the Bryan-Marsh Company, of Philadelphia. The liabilities of the two concerns are claimed to aggregate $40,000. It is said that the financial condition which caused the application was due to the companies' connection with the Camden & Trenton Railway Company, now in the hands of a receiver.

MITCHELL, S. D.—The Mitchell Illuminating and Power Company is the title of the new company which has arranged to take possession of the electric light plant and the gas plant, formerly owned by the Mitchell Gas Company. The officers of the new company are: President, D. B. Miller; vice-president, D. A. Mizener; treasurer, T. J. Spangler; secretary, F. A. White. Directors are: W. M. Smith, D. A. Mizener, D. A. Braught, Henry Swindler, F. A. White, D. B. Miller, T. J. Spangler, of this city, and James Sutherland, and George Rosenthal, of St. Louis. The new company has arranged to completely overhaul the plants.

GREELEY, COL.—Many plans are being proposed to furnish electrical power from the headwaters of the Cache la Poudre River. It is understood that the Fruit Belt Power and Irrigation Company, capitalized at $1,500,000, which proposes to develop electricity from the Grand River near Grand Junction, will also invade northern Colorado and by a series of reservoirs in the Poudre Cañon develop horse-power sufficient to furnish electricity to all towns of northern Colorado, for running sugar factories and farm machinery and provide for an electric railway. The company is said to have ample financial backing, with J. O. Hayes, a banker of Colorado Springs, and Henry C. Hall as members. Greeley parties are also interested in the project.

BIRMINGHAM, ALA.—The North Birmingham city council has passed an ordinance calling an election on April 20 when the question of whether or not the town shall issue bonds to the amount of $5,000,000 to be used in the construction of a water and light plant on the Warrior River will be voted on. It is the intention of many of the councilmen to carry out the plans of Thomas H. Friel, if the election carries, which calls for the construction of a dam across the river near Phillips Ferry, in the northeast corner of Walker County, twenty-eight miles from North Birmingham. The plant will be erected not far from the dam for the purpose of supplying the city both with water and electricity. If the proposition carries Greater Birmingham will have to assume the bonds on October 1, 1909, when the Greater Birmingham bill goes into effect.

KNOXVILLE, TENN.—An ordinance granting a franchise to the French Broad Power Company for a term of forty-five years, to furnish electric power within the corporate limits of the city of Knoxville, has been passed by the city council. Before final passage, the ordinance was amended in several particulars. The amendments provide that the work must begin by September 3, 1909, and that the plant must be in operation by March 3, 1912. The company must, within thirty days after the stipulations of the ordinance, submit to the recorder a check for $1,000 as an evidence of good faith, and upon the completion of the plant, pay the city $4,000 per annum for the first four years, and then $6,000 per annum until one per cent of the gross earnings in the city amounts to $6,000 per annum. After this the company shall pay the city one per cent of its gross earnings.

### TELEPHONE AND TELEGRAPH.

ROCHESTER, N. H.—The local telephone exchange was destroyed by a $150,000 fire which consumed the Dodge Block. The company's loss is estimated at $15,000. A new exchange will be installed in the Wentworth Block.

SALT LAKE CITY, UTAH—Government telephone lines built by the United States forest service are to have connections with the system of the Rocky Mountain Bell Telephone Company throughout the intermountain region, according to a contract entered into by the company and the government.

ROCHESTER, N. Y.—Justice Foote has confirmed the sale of the properties of the United States Independent Telephone Securities Company, including the Utica Home Telephone Company, to the reorganization committee. It is reported that there has been a large increase of the bondholders who are consenting to the plan of the committee to form a holding company at Syracuse.

TREZEVANT, TENN.—The Trezevant Telephone Company, which was organized in this city about three months ago, now has its system in operation. It has proven so far to be a success. This is an independent company and its stockholders are the subscribers. The company has been incorporated with a capital stock of $1,000. Connection will be had with the independent systems at Atwood, McKenzie, Martin, Gleason and other places in west Tennessee.

WILDWOOD-BY-THE-SEA, N. J.—The city council of Wildwood has passed an ordinance giving to the Eastern Telephone and Telegraph Company, which is a branch of the Keystone Telephone Company, of Philadelphia, the rights and privileges of laying conduits and erecting poles and wires for the installation of a telegraph and telephone system. The company announces that it contemplates miscellaneous additions to its plant this year approximating $300,000. C. E. Wilson, Philadelphia, Pa., is general manager.

### DATES AHEAD.

Iowa Electrical Association. Annual meeting, Des Moines, Iowa, April 22-23.

Iowa Street and Interurban Railway Association. Annual meeting, Des Moines, Iowa, April 23-24.

American Electrochemical Society. Next meeting, Albany, N. Y., April 30-May 2.

Nebraska Electrical Trades Association. First annual electrical show, Auditorium, Omaha, Neb., May 4-9.

Nebraska Electrical Association. First annual meeting, Omaha, Neb., May 6-7.

West Virginia Independent Telephone Association. Annual meeting, Fairmont, W. Va., May 7-9.

Southwestern Electrical and Gas Association. Annual convention, El Paso, Tex., May 7-9.

Railway Signal Association. Next meeting, New York city, May 12.

Ohio Society of Mechanical, Electrical and Steam Engineers. Next meeting, Columbus, Ohio, May 15-16.

National Electric Light Association. Annual meeting, Chicago, Ill., May 19-22.

Telephone Association of Texas and Louisiana. Annual meeting, Dallas, Tex., May 25-27.

American Institute of Electrical Engineers. Annual meeting, Atlantic City, N. J., June 29-July 2.

National Electrical Contractors' Association. Next meeting, Chicago, Ill., July 15.

American Society of Municipal Improvements. Annual meeting, Atlantic City, N. J., October.

### INDUSTRIAL ITEMS.

THE BROOKFIELD GLASS COMPANY, New York city, announces the removal of its general offices to the United States Express Building, Trinity Place, Greenwich and Rector streets.

THE GOLDSCHMIDT THERMIT COMPANY, New York city, has published an interesting bulletin entitled "Reactions." This illustrates and describes a number of very interesting applications of thermit welding.

THE DAYTON FAN AND MOTOR COMPANY, Dayton, Ohio, has ready for distribution its catalogue devoted to ceiling and desk fans for both direct and alternating currents. Copies of this catalogue will be furnished to those interested upon request.

THE AMERICAN STEEL AND WIRE COMPANY, The Rookery, Chicago, Ill., has published a very interesting bulletin devoted to the eradication of farm weeds by sulphate of iron. This bulletin indicates a really remarkable condition of affairs, and shows conclusively that extremely good results may be secured by the utilization of this material.

DOSSERT & COMPANY, 242 West Forty-first street, New York city, have received an order for 400 solderless cable connectors from the San Francisco Gas and Electric Company. F. A. Lawson & Company, Pacific Coast agents for the Dossert company, write that Dossert solderless connectors have been specified in the plans for the wiring of the new Palace Hotel, San Francisco.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has ready for distribution a bargain list of motors which have been taken in by the company on an exchange basis. These have all been tested, such repairs as were necessary have been made, and they are offered with the same guarantee as obtains on new apparatus. These motors are offered subject to order before April 15.

THE WESTERN ELECTRIC COMPANY, Chicago, Ill., has issued its 1908 catalogue devoted to electrical supplies. This is a very substantial volume and contains lists of every conceivable piece of electrical apparatus. In addition to the descriptive matter there are included data which will be found of value to the distributor and salesman. There is an index to code words, a list number index, and a material index alphabetically arranged.

THE BUCKEYE ENGINE COMPANY, Salem, Ohio, is calling attention to its success in marketing the Buckeye electric blueprinting machine. A short time ago the company secured a large amount of bent plate glass, which is used in the construction of this machine, at a very low figure. One hundred of these machines were immediately offered for sale at greatly reduced prices. The company now announces that only a few of these are left, and the opportunity to secure one under these circumstances will not remain open much longer.

THE DOUBLEDAY-HILL ELECTRIC COMPANY, Pittsburg, Pa., announces that owing to large increases in the demands on its winding and repair departments it has doubled its capacity by leasing new quarters in the Bindley Hardware Building, at Shadyside Station, Pittsburg. At this point it will have the best trackage and direct express facilities. The company has put in additional machinery which will enable it to build an armature complete. The company also manufactures trolley wheels, connectors and special electrical machinery.

THE LOCKE INSULATOR MANUFACTURING COMPANY, Victor, N. Y., has appointed as its agents for eastern Canada the Engineering Equipment and Supply Company, Lindsay Building, Montreal, Canada. The company is ready to place in the hands of engineers interested, information concerning the Locke company's product. S. W. Smith, of the Engineering Equipment and Supply Company, has long been associated with the lighting interests of Montreal, and for a considerable time was connected with the Canadian Westinghouse Company as sales engineer.

THE UNITED INDURATED FIBRE COMPANY, Lockport, N. Y., has closed a contract with the Philadelphia Rapid Transit Company for the insulation of practically all of its Wilgus and Sprague under-running third rail. Experiments have been conducted for the last year and a half with indurated fibre. The Philadelphia company finds this the best suited to its needs, and also announces that it has great insulating powers. This is a decided victory for the United Indurated Fibre Company, as the competition with wooden covers has been very strong. The fibre company now has out estimates for eighty-five miles of similar rail covering.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., has recently completed the installation of a large number of motors for the San Rafael Paper Manufacturing Company of Mexico. These motors vary in capacity from ten

to 150 horse-power. They will be used in the operation of several machines and tools in the factory of the San Rafael Company, which is located about thirty-six miles from the City of Mexico. The company obtains its electric current for driving the motors from the Mexico Light and Power Company at a potential of 20,000 volts. Six 120-kilowatt, oil-insulated transformers reduce this current to a working pressure of 440 volts. A switchboard to control the various transformers and motor circuits is furnished with the contract as well as a number of individual switchboard panels located near each motor. This installation is considered the most modern and economical plant of its kind in the republic of Mexico.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has issued an interesting sixteen-page pamphlet, No. 4,561, devoted to Edison Gem high-efficiency incandescent units. A large number of illustrations of Gem lamps and fixtures are shown, and illumination tables giving the foot-candle values on different horizontal planes when the lamp is used with various types of Holophane reflectors are included. The unit is easily renewed, fits the standard socket and burns on any standard circuit. It gives a perfect distribution of light, with a downward efficiency of from 1.75 to nearly one watt per candle. The quality of light is brilliant, soft and uniform, making it especially useful for interior lighting. A four-page folder which the company has ready for distribution describes "G-I" flame arc lamps. This lamp is a simple and efficient American development of the flame arc principle, using gravity feed without clock mechanism. The lamp is suitable for any standard make of flame arc carbons, is handsome in appearance, and very efficient in operation.

THE BROWN HOISTING MACHINERY COMPANY, Cleveland, Ohio, has published a very interesting catalogue devoted to the "Brownhoist" locomotive cranes equipped with the Brown patent grab buckets for handling coal, ore, sand, ashes, etc. The illustrations show the crane handling coal from stock piles, gondola cars, barges, etc., and the possibilities attending the use of this equipment are at once apparent. The crane, in general, consists of a boom, drums, engines, boiler, etc., mounted on a bed which is supported by and rotates on a steel car. The boiler and heavy frame supporting it rotate opposite to and counterweight the load. the crane can be used to push or pull cars, and in this way take the place of a switching engine. Under its own power the locomotive crane has the functions of hoisting, rotating, traveling, and of raising and lowering the boom. These motions, as well as the opening and closing of the grab bucket, are all under the control of the operator. The car frame or body can be mounted on either four rigid wheels or on two sets of swivel trucks. The swivel trucks are standard Master Car Builders' trucks equipped with standard couplers, train pipe, etc., enabling the crane to be put behind an engine or coupled into a regular train and moved at high speed from place to place. When used in this way the traveling mechanism is thrown out of gear by means of sliding gears on the truck axles.

# Record of Electrical Patents.

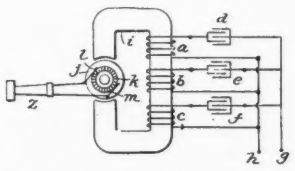
**Week of March 17.**

881,934. PROCESS OF PRODUCING ALUMINUM-MAGNESIUM ALLOYS. Franz Von Kügelgen and George O. Seward, Holcombs Rock, Va., assignors to Virginia Laboratory Company, New York, N. Y. Magnesium oxide is dissolved in a fused salt of low specific gravity and electrolyzed in the presence of a cathode of molten aluminum-magnesium alloy.

881,938. BLOCK SIGNAL. Don D. Miles, Jr., Aurora, Ill. The signals are controlled by an electromagnetic device actuated by the car.

881,943. ELECTRIC-LIGHT SIGN. Mortimer Norden, New York, N. Y., assignor to the Electric Carriage Call Company, New York, N. Y. A sign built up of a number of plates, each having holes representing numerals or letters through which the lamps project.

881,963. DISTRIBUTION FIXTURE. William D. Scott, Buffalo, N. Y. The insulators are supported on a number of adjustable collars.




882,026.—MEANS FOR TRANSMITTING ELECTRIC CURRENTS WITH INCREASED ENERGY.

881,965. FUSE AND FUSE-BOX. Frank L. Sessions, Columbus, Ohio, assignor, by mesne assignments, to the Jeffrey Manufacturing Company. The attachment jaws for the fuse may be secured to the base plate in a number of positions.

881,967. ELECTRIC INSULATOR. Charles R. Slusser, Montpelier, Idaho. An insulator with a diagonal slot for the conductor.

881,968. ELECTRIC KETTLE. David C. Smith, Kalgoorlie, Western Australia, Australia. The heater is enclosed in an inclined rectangular chamber.

881,985. PLUG-SEAT SWITCH. Bernard O. Wells, Charleston, Ill., assignor to Sterling Electric Company, La Fayette, Ind. The plug is held in position by an extension secured to the seat.

881,986. AUTOMATIC GAS ANALYZER. Henry J. Westover, New York, N. Y. The proportions of a given gas mixture are controlled through electrical means by two independently movable floats.

882,003. ELECTRICAL IGNITING APPARATUS. Edward S. Huff, Detroit, Mich., assignor to Henry Ford, Detroit, Mich. A condenser is inserted in the induction coil circuit, a portion of the circuit being shunted by the charging generator.

882,026. MEANS FOR TRANSMITTING ELECTRIC CURRENTS WITH INCREASED ENERGY. Julian A. Stratton, Chicago, Ill. A generator with a number of field windings, each including a condenser and adjusted to have a separate frequency of oscillation.

882,041. INSULATING RAIL JOINT. Benjamin Wolhaupter, New York, N. Y., assignor to the Rail Joint Company. A joint bar of insulating material is interposed between the rails and the girder-plate.

882,048. INDUCTION-COIL. Melville S. Brigham, Detroit, Mich., assignor of one-half to A. R. Bliss, Lowell, Mass. A number of open magnetic circuit coils grouped together, each with independent windings, and means for various coupling arrangements.

882,075. PROCESS FOR SEPARATING THE METALS CONTAINED in copper-nickel matte. James M. Neil, Toronto, Ontario, Canada, assignor to Frederic C. Norris, trustee, Detroit, Mich. The matte is treated with sulphuric acid, the resulting sulphate being electrolyzed between a copper-nickel anode and a copper cathode.

882,089. ELECTRICAL SIGNALING APPARATUS. Benjamin F. Wooding, Denver, Col. The signals, both on the train and along the track, are controlled by a source of current on the train, acting through signal lines and a contact device.

882,095. WIRE TIE FOR INSULATORS. Waldo E. Callane, Flora, Ind. A tie of stiff resilient wire which is sprung over the insulator and the conductor.

882,096. LIGHTNING ARRESTER. Franklin P. Cauble, Lincolnton, N. C. The conductors are wound on hollow cylinders which are slotted longitudinally.

882,110. ANODE. Albert M. Hill, New Haven, Ct., assignor to C. Upham Ely, Brooklyn, N. Y. An anode with a dove-tailed head for locking in the suspension rod.

882,118. ANNUNCIATOR. John T. Needham, Bayonne, N. J., assignor of one-half to Postal Telegraph-Cable Company, New York, N. Y. A combined annunciator and signal.

882,139. RESTORING ATTACHMENT TO TROLLEY WHEELS AND ELECTRIC SIGNAL FOR THE SAME. George H. Brooks, Louisville, Ky., assignor to Grauman, Beckman & Brooks, Louisville, Ky. A relatively long grooved finder attached to the harp.

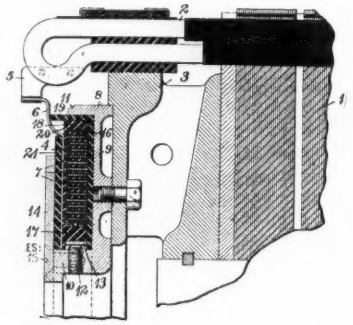
882,141. CABLE INSULATING AND TESTING SYSTEM. Troy Cope, New Waterford, Ohio. Air passages are provided in the cables and means for passing dried air through.

882,143. BLOCK-SIGNAL SYSTEM. William Daves, Bloomington, Ill., assignor to the Inter-State Signal Company, Camden, N. J. The lock for the signal is controlled electrically.

882,144. STORAGE-BATTERY ELECTRODE. Thomas A. Edison, Llewellyn Park, Orange, N. J., assignor to Edison Storage Battery Company, West Orange, N. J. The flaky active material of an alkaline battery is supported in a conducting non-active structure.

882,153. TROLLEY HEAD. James Lennox, Brackenridge, Pa. The wheel proper is provided with trunnions which engage in openings in the harp.

882,157. SAFETY APPLIANCE FOR RAILWAY TRAINS. Robley C. Millard, Atlanta, Ga. Electric controllers for operating the brake valves.



888,242.—Cross Connection for Dynamoelectric Machines.

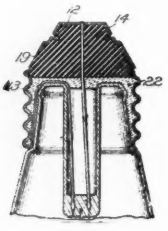
882,158. MAGNETIC ORE SEPARATOR. Richard R. Moffatt, New York, N. Y., assignor to Imperial Ore Separator Company. An endless conveyer carries the ore between two sets of upper and lower magnetic poles.

882,169. ELECTRODE. Marcus Ruthenburg, Philadelphia, Pa. An electrode of a solid mass of uniform non-ferruginous composition.

882,218. ELECTRIC-DISCHARGE APPARATUS. Percy H. Thomas, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. A discharge plate having an area large in comparison with its thickness.

882,225. FLUSH RECEPTACLE. Frank T. Wheeler, Plainville, Ct., assignor to Trumbull Electric Manufacturing Company, Plainville, Ct. A method of construction.

882,242. CROSS CONNECTION FOR DYNAMOELECTRIC MACHINES. William H. Foot, Wilkinsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. An annular case, supported by the core structure, encloses the end connections.



882,257.—Incandescent Lamp.

882,250. FIRE-ALARM BOX. Maynard W. Hamblin, Milwaukee, Wis., assignor to American District Telegraph Company, New York, N. Y. An open-circuit system.

882,257. INCANDESCENT LAMP. Matthew M. Merritt, Middleton, Mass., assignor to National Electric Lamp Company, Cleveland, Ohio. A lamp with a base covered with an electrolytically deposited shell.

882,258. PROCESS FOR THE MANUFACTURE OF INCANDESCENT-LAMP BASES. Matthew M. Merritt, Middleton, Mass., assignor to National Electric Lamp Company, Cleveland, Ohio. The shell is deposited electrolytically on the base.

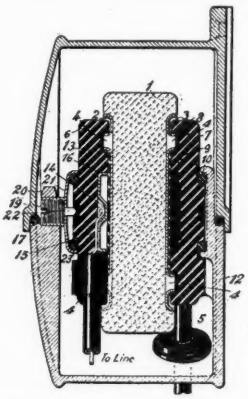
882,265. LIGHTNING ARRESTER. Newitt J. Neall, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. The discharge block has recesses into which projections on the conducting plates fit.

882,276. ELECTRIC SIGNALING SYSTEM. John D. Taylor, Edgewood Park, Pa., assignor to the Union Switch and Signal Company, Swissvale, Pa. A continuous-rail block system, portions of the rails being provided with increased impedance.

882,292. FLEXIBLE CONDUIT. William S. Brown, New York, N. Y. A conduit consisting of a number of superposed layers, two of which are plastic and one containing resilient strips.

882,327. CIRCUIT-CONTROLLING DEVICE FOR TELEGRAPHONES. John A. Lieb, New York, N. Y., assignor to American Telegraphone Company. A commutating switch controlling the connections.

882,328. AMPLIFYING MAGNET SYSTEM FOR TELEGRAPHONES. John A. Lieb, New York, N. Y., assignor to American Telegraphone Company. A number of recording magnets are attached to the talking circuit, each of which makes its own record.



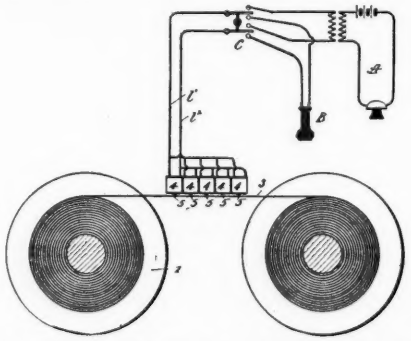

882,265.—Lightning Arrester.

882,329. TELEGRAPHONE. John A. Lieb, New York, N. Y., assignor to American Telegraphone Company. A hollow drum into which the steel recording strip is sprung.

882,337. JUNCTION-BOX FOR ELECTRICAL CONDUITS. Adnah McMurtrie, New York, N. Y., assignor to Thomas & Betts, New York, N. Y. A curb with a non-abrasive shoulder for insertion in junction boxes.

882,340. ELECTRICALLY CONTROLLED SWITCH MECHANISM. Granville E. Palmer, Boston, Mass., assignor of one-fourth to Charles B. Price and one-fourth to Frank S. Price, Salem, Mass. A solenoid switch acting through toggle joints.

882,347. COMPOSITE SIGNALING AND TELEPHONE SYSTEM. Harry O. Rugh, Sandwich, Ill. The telephone and telegraph signals are separated by an inductive bridge.



882,328.—Amplifying Magnet System for Telegraphones.

882,388. ELECTRIC OIL SWITCH. John D. Hilliard, Jr., and Charles E. Parsons, Glens Falls, N. Y. A rocking oil switch.

882,424. INSULATOR PIN. William Scharfhausen, Payette, Idaho, assignor to Payette Insulator Pin Company, Limited, Payette, Idaho. A pin is provided with a longitudinal slot and a locking key.

882,450. TROLLEY. Frank E. Brazeal, Monson, Mass., assignor of one-half to Herman S. Mowry, North Adams, Mass. The wheel is provided with oil reservoirs.

882,523. BLOCK-SIGNAL SYSTEM. Frank E. Kinsman, Plainfield, N. J. A system for electric railways.

882,531. ROTARY CONVERTER. John L. Murdock, Bound Brook, N. J. A three-phase rotary with three windings and a two-part commutator for each.